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(54) Battery pack, battery loading device, power supplying device and electronic equipment

(57) A battery pack is provided which positively prohibits incorrect loading on a battery loading device inappropriate for the battery pack. To this end, the battery pack includes a battery cell, a casing 19 housing the battery cell, and first to third output terminals 21-23 for outputting the power of the battery cell. The casing 19 has a front surface 20, on which the output terminals 21-23 are arranged, and a bottom surface 24 extending substantially at right angles to the front surface 20. A discriminating recess 30 having a discriminating groove 32 is formed at a mid portion of the bottom surface 24.

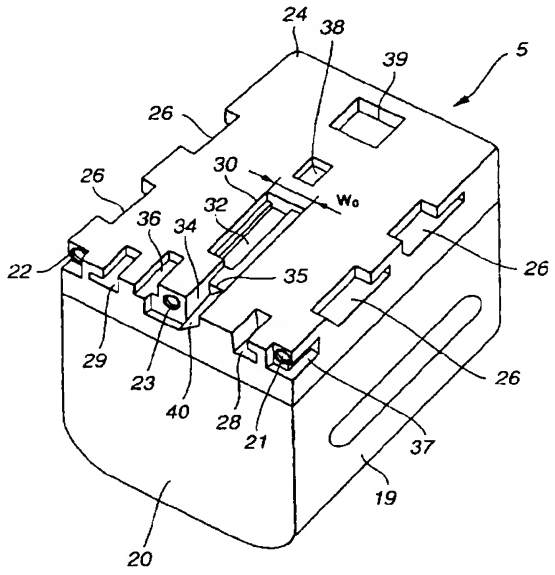

FIG.3

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Description

[0001] This invention relates to a battery pack, having housed therein a battery cell, preferably of charging type, used e.g., as a power source of electronic equipment, a battery device on which is loaded the battery pack etc, and to external equipment having the battery device on which is loaded the battery pack etc. This invention also relates to a power supplying device for outputting the power furnished from e.g., an external power source.

[0002] There has hitherto been known a battery pack having therein a battery cell used as a power source for an electronic equipment. This sort of the battery pack is detachably loaded on a battery loading device provided on the main body portion of the electronic equipment.

[0003] The battery pack is made up of a battery cell for supplying the power, a casing having this battery cell housed therein, and an output terminal connected to a connection terminal on the battery loading device. The battery cell provided on the battery pack is chargeable, such that, on power depletion, it is charged through the output terminal. The battery casing has guide grooves on both lateral sides thereof engaging with the battery loading device. The output terminal is arranged adjacent to the bottom surface of the casing so that its one end faces a longitudinal lateral side thereof.

[0004] The battery loading device includes a loading section for loading the battery pack and a terminal for connection to the output terminal of the battery pack. The loading section is formed with a setting surface slightly larger in area than the outer size of the battery pack and on which the bottom surface of the battery pack is set. On the surfaces of the loading section facing both lateral sides of the battery pack are formed guide projections engaged in the guide grooves formed in the battery pack. The terminal section is arranged on the inner rim of the loading section for facing the output terminal of the loaded battery pack. On loading the battery pack on the loading section, the terminal section is connected to the output terminal of the battery pack to permit the power to be supplied.

[0005] With the above-described structure of the battery loading device, the operation of loading the battery pack on the loading section of the battery loading device is hereinafter explained. When loading the battery pack on the loading section of the battery loading device, the respective guide projections on the loading section are engaged in the respective guide recesses with the bottom surface of the battery pack substantially parallel to the setting surface of the loading section. When loaded on the battery loading device, the battery pack furnishes the power from the battery cell to an electronic equipment provided with the battery loading device through the output terminal connected to the terminal section in the loading section.

[0006] Meanwhile, there are plural sorts of the battery packs having different specifications, such as charging capacity, size or shape of the casing or the position or shape of the output terminal, depending on the objectives for use. Thus, the battery pack suffers from the problem that it may be inadvertently loaded on a battery loading device which is not appropriate to the battery pack in question because of the difference in the specifications.

[0007] If a battery pack in question is inadvertently loaded on the battery loading device not appropriate to the battery pack in question, there is raised a problem of possible destruction of the loading section, output terminal or the connection terminal. Also, if the battery pack is inadvertently loaded in an imperfect state on the loading section of the battery loading device, there is raised a problem of descent of the battery pack from the battery loading device thus leading to possible destruction of the battery pack.

[0008] It is therefore necessary to prevent the battery pack from being inadvertently loaded on the battery loading devices of different specifications other than the battery loading device suited to or compatible with the battery pack. It is similarly necessary to prevent an inappropriate battery pack from being inadvertently loaded on the battery loading device.

[0009] It is therefore an aim of the present invention to provide a battery pack which can be positively prevented from being inadvertently loaded on an inappropriate battery loading device.

[0010] It is another aim of the present invention to provide a battery loading device in which loading thereon of an inappropriate power supplying device can positively be prevented from occurring.

[0011] It is still another aim of the present invention to provide a power supply device which can be positively prevented from being inadvertently loaded on an inappropriate battery loading device.

[0012] It is yet another aim of the present invention to provide electronic equipment in which loading thereon of an inappropriate power supplying device can positively be prevented from occurring.

[0013] Accordingly, the present invention provides a battery pack which includes a recess made up of plural steps at a mid portion of a second surface of the casing.

[0014] When the present battery pack is loaded on a battery loading device, a projection of the battery loading device is engaged in the recess made up of plural steps to verify whether or not the battery loading device in question is an appropriate one for the battery pack.

[0015] The battery loading device according to the present invention includes a projection made up of plural steps at a mid portion of a second surface.

[0016] When a power supply member is loaded on the battery loading device, the plural steps of the projection are engaged with the power supply member to discriminate whether or not the power supply member to be loaded on the battery loading device is appropriate

for the battery loading device.

[0017] With the power supply device according to the present invention, a recess made up of plural steps is formed at a mid portion of a second surface.

[0018] When the power supply device is loaded on electronic equipment, the plural steps of the projection are engaged with the power supply device to discriminate whether or not the power supply device being loaded is suited to the electronic equipment.

[0019] The battery pack of the present invention can be positively prevented from being erroneously loaded on an inappropriate battery loading device.

[0020] With the battery loading device of the present invention, a power supply member inappropriate for the device can be positively prohibited from being erroneously loaded thereon.

[0021] The power supply device of the present invention can be positively prohibited from being erroneously loaded on a battery loading device inappropriate for the power supply device.

[0022] Also, with the electronic equipment of the present invention, a power supply member inappropriate for the equipment can be positively prohibited from being erroneously loaded thereon.

[0023] Preferred embodiments of the present invention will now be described hereinbelow by way of example only with reference to the accompanying drawings, in which:

Fig.1 is a perspective view showing a video camera apparatus having a battery loading mechanism according to the present invention.
Fig.2 is a perspective view showing a first battery pack according to the present invention.
Fig.3 is a perspective view looking from the bottom side of the first battery pack.
Fig.4 is a perspective view showing a first battery loading device according to the present invention.
Fig.5 is a perspective view showing a terminal section of the battery loading device.
Fig.6 is a front view showing the terminal section.
Fig.7 is a perspective view showing a connection terminal of the terminal section.
Fig.8 is a side view looking from the side of the terminal section, and showing the state in which, when the first battery pack is loaded on the first battery loading device, the first battery pack is loaded with a tilt in the longitudinal direction.
Fig.9 is a side view showing the state in which, when the first battery pack is loaded on the first battery loading device, the first battery pack is loaded with a tilt in the longitudinal direction.
Fig.10 is a side view looking from the side of the terminal section, and showing the state in which, when the first battery pack is loaded on the first battery loading device, the first battery pack is loaded with a tilt in the width-wise direction.
Fig.11 is a side view showing the state in which, when the first battery pack is loaded on the first battery loading device, the first battery pack is loaded with a tilt in the width-wise direction.
Figs.12A and 12B are perspective views showing a modified discrimination recess and a modified discrimination projection.
Figs.13A and 13B are perspective views showing a further modified discrimination recess and a further modified discrimination projection.
Figs.14A to 14D are perspective views showing another modified discrimination recess and another modified discrimination projection.
Figs.15A to 15C are perspective views showing still another modified discrimination recess and still another modified discrimination projection.
Fig.16 is a perspective view looking from the bottom side and showing a second battery pack.
Fig.17 is a perspective view looking from the bottom side and showing a third battery pack.
Fig.18 is a perspective view showing a third battery pack.
Fig.19 is a perspective view showing the third battery pack, looking from the bottom side.
Fig.20 is a perspective view showing a fourth battery pack.
Fig.21 is a perspective view of the fourth battery pack, looking from the bottom surface.
Fig.22 is a perspective view showing a second battery loading device.
Fig.23 is a perspective view showing a third battery loading device.
Fig.24 is a perspective view showing a fourth battery loading device.
Fig.25 is a perspective view showing a first illumination device according to the present invention.
Fig.26 is a perspective view showing portions of the first illumination device.
Fig.27 is a perspective view showing a second illumination device.
Fig.28 is a perspective view showing portions of the second illumination device.

[0024] Referring to the drawings, a battery pack and a battery loading device having a battery loading mechanism for loading the battery pack according to the present invention will be explained in detail. It is noted that a battery pack 5 and a battery loading device 6, provided on the battery loading mechanism, are applied to a video camera apparatus 1, as shown for example in Fig.1.

[0025] The battery pack 5 may be of a high capacity type, a standard capacity type or of a low capacity type, depending on the size of the charging capacity of the battery cell. The battery pack 5 may also be of the plate type adapted to be supplied with power from an external power source. There are different battery loading devices associated with these different sorts of battery packs.

[0026] Referring first to Figs.2 and 3, the first battery pack 5, used as a high capacity type, includes a battery cell, not shown, a casing 19, housing therein the battery cell, and plural output terminals 21 to 23 connected to the battery cell.

[0027] The first battery pack 5 includes a casing 19 formed of, for example, a synthetic resin material. Referring to Figs.2 and 3, the casing 19 has guide grooves 26, 26 on its both width-wise lateral sides for guiding the casing as to the loading direction to a first battery loading device 6. The guide grooves 26, 26 on both lateral sides of the casing 19 are opened at one ends thereof on the bottom surface 24 of the casing 19 and are arrayed side-by-side in the longitudinal direction of the casing 19, as shown in Fig.3.

[0028] On a front surface 20 of the casing 19 in the loading direction to the first battery loading device 6, there are provided a first output terminal 21 and a second output terminal 22 on both width-wise lateral sides of the casing 19. At a width-wise mid portion of the front surface of the casing 19, there is provided a third output terminal 23. The first and second output terminals 21, 22 furnish the power through the battery loading device 6 to a main body portion of the video camera apparatus 1. The third output terminal 23 outputs information signals, such as residual power of the battery cell, to the main body portion of the video camera apparatus 1. The outwardly directed ends of the output terminals 21 to 23 are positioned in substantially rectangular recesses formed in the front surface 20 of the casing 19. Thus, these ends of the are prohibited from being destroyed due to abutment against the portions other than the connection terminals of the battery loading device.

[0029] The casing 19 of the first battery pack 5 is provided with a pair of control recesses 28, 29 for regulating the tilt in the width-wise direction of the bottom surface 24 of the casing 19 with respect to the first battery loading device 6 when the casing 19 is loaded on the appropriate first battery loading device 6, as shown in Fig.3. These control recesses 28, 29 are formed line-symmetrically in the front surface 20 with respect to a width-wise mid line, not shown, in the inserting direction into the first battery loading device 6, as shown in Fig.3.

[0030] These control recesses 28, 29 are each provided with a first portion extending at right angles to the bottom surface 24 of the casing 19 and a second portion extending at right angles to the first portion, and hence are substantially L-shaped in cross-section, as shown in Fig.3.

[0031] The first battery pack 5 also includes, at a mid portion in the bottom surface 24 of the casing 19, a substantially rectangular discrimination recess 30 for discriminating whether or not the battery loading device for loading is an appropriate battery loading device, as also shown in Fig.3.

[0032] The discrimination recess 30, thus located substantially on the width-wise centerline of the casing 19, is formed from the mid position of the bottom surface 24 of the casing 19 towards the front surface 20, as shown in Fig.3. In the bottom surface in the discrimination recess 30, a substantially rectangular discrimination groove 32 is formed on substantially the width-wise centerline of the casing 19 in continuation to the longitudinal ends of the discrimination recess 30, as shown in Fig.3. Thus, the inside of the discrimination recess 30 is formed with steps on both width-wise ends of the bottom surface 24 of the casing 19, as shown in Fig.3. This discrimination recess 30 has a size W_0 in a direction parallel to the width of the bottom surface 24.

[0033] The first battery loading device 6 also includes a first guide groove 34, adjacent to the third output terminal 23, as shown in Fig.3. The first guide groove 34 is formed parallel to the longitudinal direction of the casing 19 for guiding the loading direction to the first battery loading device 6. This first guide groove 34 has its one end opened in the front surface 20 of the casing 19, while having its other end extended in continuation to the discrimination recess 30. Adjacent to the front surface 20 of the casing 19, there is formed in the first guide groove 34 a step 35 having a different depth, that is a different size in the direction perpendicular to the bottom surface 24 of the casing 19.

[0034] In the bottom surface 24 of the casing 19, there is formed a second guide groove 36, at an opposite side of the third output terminal 23 with respect to the first guide groove 34, as shown in Fig.3. This second guide groove 36 is formed parallel to the longitudinal direction of the casing 19 and has its one end opened in the front surface 20 of the casing 19.

[0035] In both width-wise lateral sides of the casing 19, there are formed control grooves 37, 37, adjacent to the first and second output terminals 21, 22, so as to be opened in the front surface 20 substantially parallel to the bottom surface 24. These control grooves 37, 37 serve for regulating the tilt in the width-wise direction of the bottom surface 24 with respect to the first battery loading device 6.

[0036] In the bottom surface 24 of the casing 19, there are formed a first lock recess 38 and a second lock recess 39 engaged by the first battery loading device 6 when the casing is loaded on the first battery loading device 6. The first lock recess 38 is substantially rectangular in profile and is located substantially on the width-wise centerline of the casing 19 in adjacency to the discrimination recess 38. The second lock recess 39, slightly larger in size than the first lock recess 38, is substantially rectangular in profile and is formed on the back side in the loading direction on substantially the width-wise centerline of the casing 19.

[0037] The first battery loading device 6 includes a loading section 43 having a setting surface 45 on which to set the bottom surface 24 of the battery pack 5, and a terminal section 44 to which are connected respective output terminals 21 to 23 of the first battery pack 5, as shown in Fig.4. The loading section 43 is slightly larger in size than the bottom surface 24 of the first battery

pack 5, and is formed with guide projections 47, 47 engaged with the guide grooves 26, 26 of the first battery pack 5, as shown in Fig.4. The guide projections 47 are formed on the inner lateral sides in the width-wise direction of the first battery pack 5 in adjacency to the setting surface 45.

[0038] When the first battery pack is loaded in position, the loading section 43 sets the bottom surface 24 of the casing 19 so as to be parallel to the setting surface 45, by the guide projections 47, 47 engaging in the guide grooves 26, 26 of the casing 19, as the loading section 43 holds the first battery pack 5.

[0039] The terminal section 44 is arranged on an abutment surface 46 facing the front surface 20 of the loaded first battery pack 5, as shown in Figs.4 and 5. With the terminal section 44, a first connection terminal 51 and a second connection terminal 52, connected respectively to the first and second output terminals 21, 22 of the first battery pack 5, are provided on both sides along the width-wise direction of the loading section 43, as shown in Figs.4 and 6. Also, with the terminal section 44, a third connection terminal 53, connected to the third output terminal 23 of the first battery pack 5, is located at a mid portion along the width-wise direction of the loading section 43, as shown in Figs.4 and 6.

[0040] On the abutment surface 46 of the loading section 43, there are formed first to third connection terminals 51 to 53 parallel to the bottom surface 24 of the first battery pack 5 and to the longitudinal direction of the first battery pack 5, as shown in Figs.4 and 5. Each of the first to third connection terminals 51 to 53 is provided with a terminal plate 55, intruded into each of the first to third output terminals 21 to 23 of the first battery pack 5 and a protection member 56 for protecting the terminal plate 55.

[0041] The terminal plate 55 has its major surface substantially parallel to the getting surface of the loading section 43, while having its proximal end supported by the abutment surface 46 of the loading section 43. The terminal plate 55 is fractionated by having a cut-out 57 formed at its distal end so that the distal end is elastically flexible in the width-wise direction.

[0042] The protection member 56 is a substantially semi-tubular substrate bent at a mid portion along the longitudinal direction of the substrate, with the terminal plate 55 in-between, as shown in Fig.7. The distal end of the terminal plate 55 is elastically flexibly protruded from the folded distal end to both width-wise lateral sides of the protection member 56,

[0043] When the connection terminals 51 to 53 are intruded into the output terminals 21 to 23 of the first battery pack 5, the distal ends of the terminal plates 55 are elastically flexed in the width-wise direction to establish the electrical connection by the terminal plates 55 positively compressing against the output terminals.

[0044] The connection terminals 51 to 53 are improved in tenacity against the thrusting force from the height-wise direction of the first battery pack 5, corresponding to the depth-wise direction of the loading section 43, when the bottom surface 24 of the first battery pack 5 is erroneously abutted thereon during loading of the first battery pack 5 on the loading section 43. Thus, the terminal plates 55 may be safeguarded against inadvertent destruction.

[0045] On the terminal section 44, a cover member 60 for protecting the first to third connection terminals 51 to 53 is mounted for rotation in the direction indicated by arrows a1 and a2 in Fig.5 relative to the loading section 43, as shown in Figs.4 to 6.

[0046] The cover member 60 is formed of, for example, a synthetic resin material, and includes a substantially rectangular protective piece 61 and supporting pieces 62, 62 for supporting the protective piece 61, as shown in Figs.5 and 6. The protective piece 61 of the cover member 60 has, on its surface facing the setting surface 45 of the loading section 43, an inclined surface section 63 inclined along the thickness direction. When the first battery pack 5 is intruded into the loading section 43, the casing 19 is abutted against the protective piece 61, as the casing is inserted, so that the cover member 60 is rotated easily in the direction indicated by arrow a2 in Fig.5. The cover member 60 has the supporting pieces 62, 62 rotatably supported on the abutment surface 46 of the loading section 43 through a rotary pivot shaft, not shown. On the outer periphery of the rotary pivot shaft of the cover member 60, there is mounted a torsion coil spring, not shown. This torsion coil spring has its one end retained by the abutment surface 46 of the loading section 43, while having its other end retained by the supporting pieces 62, 62 of the cover member 60. Thus, the cover member 60 is biased by the spring force of the torsion coil spring for rotation in the direction indicated by arrow a1 in Fig.5 and is thereby moved to a position overlying the first to third connection terminals 51 to 53.

[0047] Thus, in the cover member 60, the connection terminals 51 to 53 are covered when the first battery pack 5 is not loaded on the loading section 43, so that the connection terminals 51 to 53 are positively protected against possible destruction.

[0048] Also, the loading section 43 of the first battery loading device 6 is formed as one with a pair of control projections 65, 66 astride the abutment surface 46 and the setting surface 45 substantially line-symmetrically with respect to the width-wise centerline. These control projections 65, 66, engaging with the control recesses 28, 29 of the first battery pack 5, are provided adjacent to the first and second connection terminals 51, 52, as shown in Figs.5 and 6.

[0049] These control projections 65, 66 are each provided with a first portion, perpendicular to the setting surface 45, and a second portion perpendicular to the first portion, and the hence are each formed to a substantially L-shaped cross-section. These control projections 65, 66 restrict the bottom surface 24 of the first battery pack 5 assuming a state inclined obliquely rela-

tive to the setting surface 45 of the loading section 43. The control projections 65, 66 are configured so that the height H_1 thereof in a direction perpendicular to the setting surface 45 will be larger than the height H_0 of the outer periphery of the connection terminals 51 to 53.

[0050] The loading section 43 of the first battery loading device 6 is formed as one with a first guide projection 68 adjacent to the third connection terminal 53 astride the abutment surface 46 and the setting surface 45 for guiding the insertion of the first battery pack 5. The first guide projection 68 is formed so as to be parallel to the longitudinal direction of the setting surface 45 at a position engageable in the first guide groove 34 in the bottom surface 24 of the loaded first battery pack 5.

[0051] The control projections 65, 66 and the first guide projection 68 are of a height larger than the connection terminals 51 to 53, and hence are protruded to a height level higher than the connection terminals 51 to 53, as shown in Figs.5 and 6. Thus, the control projections 65, 66 and the first guide projection 68 prohibit the outer periphery of the casing 19 from erroneously abutting against the connection terminals 51 to 53, when the first battery pack 5 is intruded from the direction perpendicular to the setting surface 45 to prevent possible destruction of the connection terminals 51 to 53. Also, the control projections 65, 66, having the substantially L-shaped cross-section, exhibit sufficient toughness.

[0052] Meanwhile, the connection terminals 51 to 53 can be protected if the control projections 65, 66 and the first guide projection 68 are of a height level substantially equal to that of the outer periphery of the connection terminals 51 to 53.

[0053] The loading section 43 is also formed as one with a second guide projection 70 astride the abutment surface 46 and the setting surface 45, parallel to the longitudinal direction of the setting surface 45, for guiding the loading direction of the first battery pack 5, as shown in Figs.4 to 6. This second guide projection 70 is engaged with the second guide groove 36 of the first battery pack 5 to guide the loading direction.

[0054] The loading section 43 of the first battery loading device 6 is formed on both width-wise lateral sides as one with control pawls 72, 72 adapted for engaging with control grooves 37, 37. These control grooves 37, 37 are parallel to the setting surface 45, while extending parallel to the longitudinal direction of the first battery pack 5.

[0055] The loading section 43 of the first battery loading device 6 is formed substantially centrally of the setting surface 45 with a discrimination projection 73 engaged with the discrimination recess 30 of the first battery pack 6, as shown in Fig.4. This discrimination projection 73 is formed substantially in a rectangular profile. The distal end of the discrimination projection 73 is formed as one with a discrimination lug 74 engaging in the discrimination groove 32 of the discrimination recess 73. This discrimination projection 73 has a size W_1 in a direction parallel to the width-wise direction of the setting surface 45 smaller than the width W_0 of the discrimination recess 30 of the first battery pack 5, as shown in Fig.4, so that the projection 73 can be intruded into the discrimination recess 30. The discrimination projection 73 also is formed at a distance L_1 from the abutment surface 46 in the direction perpendicular to the abutment surface 46, as shown in Fig.4.

[0056] The loading section 43 of the first battery loading device 6 is provided with a lock mechanism 75 adapted for holding the first battery pack 5 when the battery pack 5 is loaded in position, as shown in Fig.4. This lock mechanism 75 includes a subsequently flat-plate-shaped lock member 76 engaging with the first battery pack 5, an operating lever 77 for causing the movement of the lock member 76 relative to the setting surface 45, and a coil spring, not shown, for biasing the operating lever 77 in a direction of engaging with the first lock recess 38 of the first battery pack 5, as shown in Fig.4.

[0057] The lock member 76 is formed on its major surface with an upstanding lock pawl 79 engaging with the first lock recess 38 of the first battery pack 5, as shown in Fig.4. An opening 80 through which the lock pawl 79 of the lock member 76 is intruded and projected above the setting surface 45 is formed substantially centrally of the loading section 43.

[0058] The operating lever 77 has its distal end engaged with the lock member 76, while having its other end formed as one with an operating piece 81 adapted for performing a thrusting operation. The setting surface 45 is formed with an operating recess 82 on the back side of the first battery pack 5 loaded in the loading section 43. In the operating recess 82 is formed the protuberant operating piece 81. The operating lever 77 is moved with movement of the lock member 76 so that the operating piece 81 is protruded into the inside of the operating recess 82.

[0059] When the first battery pack 5 is loaded in the loading section 43, in the above-described lock mechanism 75, the lock pawl 79 of the lock member 76 is engaged in the first lock recess 38 to disable the movement of the first battery pack 5 loaded on the loading section 43 to hold the fist battery pack 5 in the loading section 43. In the lock mechanism 75, the operating piece 81 of the operating lever 77 is protruded into the inside of the operating recess 82 , as the lock pawl 79 of the lock member 76 is protruded from the opening 80.

[0060] Also, when dismounting the first battery pack 5 loaded on the loading section 43, in the present lock mechanism 75, the lock pawl 79 is disengaged from the lock recess 38 by thrusting the operating piece 81 of the operating lever 77 as the lock pawl 79 is engaged in the first lock recess 38. The first battery pack 5, loaded on the first battery loading device 6, is rendered movable in the loading section 43 and dismounted.

[0061] The above-described lock mechanism 75 is configured so that the lock pawl 79 of the lock member 76 is engaged in the first lock recess 38 of the first bat-

tery pack 5. Alternatively, the lock pawl 79 may be configured to be engaged in the second lock recess 39 by design change of the loading section 43.

[0062] The operation of loading the above-described first battery pack 5 on the first battery loading device 6 is explained with reference to the drawings.

[0063] First, if the first battery pack 5 is erroneously loaded into the loading section 43 of the first battery loading device 6, with the bottom surface 24 of the casing 19 being tilted in the direction indicated by arrow b in Fig.9 corresponding to the longitudinal direction of the bottom surface 24, as shown in Figs.8 and 9, the bottom surface 24 of the casing 19 is abutted against the guide projections 47, whilst the front surface 20 of the casing 19 is abutted against the control recesses 28, 29. This disables intrusion of the battery pack. Moreover, the output terminals 51 to 53 and the connection terminals 21 to 23 are positively prohibited from abutting against optional portions. Therefore, the output terminals 51 to 53 and the connection terminals 21 to 23 are positively safeguarded against possible destruction.

[0064] The first battery pack 5 is loaded satisfactorily on the first battery loading device 6, by the guide projections 47 of the loading section 43 being intruded into the respective guide grooves 26 of the casing 19. Specifically, the state of longitudinal tilting of the bottom surface 24 of the casing 19 relative to the setting surface 45 of the loading section 43 is positively controlled, as indicated by arrow b in Fig.9, with the longitudinal direction of the bottom surface 24 then being parallel to the setting surface 45.

[0065] If the first battery pack 5 is loaded on the first battery loading device 6, by applying an extremely large force as the bottom surface 24 of the casing 19 is tilted, and if a large external pressure of detaching the first battery pack 5 is applied, the output terminals 51 to 53 and the connection terminals 21 to 23 are positively safeguarded against possible destruction, since the large external force is applied to the substantially L-shaped control projections 65, 66 of higher tenacity.

[0066] If, when the first battery pack 5 is to be loaded in the loading section 43 of the first battery loading device 6, as shown in Figs.10 and 11, it is loaded erroneously, with the bottom surface 24 of the casing 19 being tilted in the direction indicated by arrow c in Fig.10 corresponding to the width-wise direction of the bottom surface 24, at least one of the control pawls 72, 72 is not inserted into the control groove, with the bottom surface 24 of the casing then abutting against the control pawl 72 and with the front surface 20 of the casing 19 abutting against the control projection. Thus, the first battery pack can positively not be intruded, such that the output terminals 51 to 53 or the connection terminals 21 to 23 are positively prohibited from abutting against other than the intended portions. This positively prohibits destruction of the output terminals 51 to 53 or the connection terminals 21 to 23.

[0067] The control projections 65, 66 of the loading section 43 are intruded into the control recesses 28, 29 of the casing 19, whereby the state of tilt in the width-wise direction of the bottom surface 24 of the casing 19 relative to the setting surface 45 of the loading section 43 is positively controlled, with the width-wise direction of the bottom surface 24 being substantially parallel to the setting surface 45 to permit the first battery pack 5 to be loaded satisfactorily on the first battery loading device 6.

[0068] Also, when the first battery pack 5 is loaded in the loading section 43 of the first battery loading device 6, the control pawls 72, 72 of the loading section 43 are engaged in the control grooves 37, 37 of the casing 19, whereby the state of tilt in the width-wise direction of the bottom surface 24 of the casing 19 relative to the setting surface 45 of the loading section 43 is positively controlled, with the width-wise direction of the bottom surface 24 being rendered substantially parallel to the setting surface 45, to permit the first battery pack 5 to be satisfactorily loaded on the first battery loading device 6.

[0069] Thus, when the first battery pack 5 is loaded in the loading section 43 of the first battery loading device 6, the first battery pack 5 is rendered substantially parallel to the setting surface 45 of the loading section 43. Stated differently, when the first battery pack 5 is loaded in the loading section 43 of the first battery pack 5, the first battery pack 5 is positively prevented from being loaded in an improper position in the loading section 43, with the bottom surface 24 of the casing 19 being then tilted in the longitudinal direction or in the width-wise direction relative to the setting surface 45.

[0070] When the first battery pack 5 is loaded in the loading section 43 of the first battery loading device 6, with the bottom surface 24 of the casing 19 being then set on the setting surface 45, the discrimination projection 73 of the setting surface 43 is intruded into the discrimination recess 30 of the bottom surface 24, at the same time as the discrimination lug 74 is intruded into the discrimination groove 32, whereby it is discriminated that the first battery pack 5 is suited to the first battery loading device 6. When the first battery pack 5 is loaded on the first battery loading device 6, the first battery loading device 6 checks whether or not the first battery pack 5 is appropriate for the first battery loading device 6 based on whether or not the discrimination projection 73 of the setting surface 45 can be intruded into the discrimination recess 30 of the bottom surface 24, that is based on the relative position between the discrimination recess 30 and the discrimination projection 73, and also based on whether or not the discrimination lug 74 can be intruded into the discrimination groove 32.

[0071] Although the discrimination recess 30 and the discrimination projection 73 are discriminated from each other based on the position in the longitudinal direction of the bottom surface 24 of the casing 19, they may also be discriminated from each other based on the position in the width-wise direction of the bottom surface

24.

[0072] The first battery pack 5 and the first battery loading device 6 are formed with the control recesses 28, 29 and with the control projections 65, 66 of the substantially L-shaped cross-section of same profile, these recesses or projections may, of course, be configured as control recesses 85 or control projections 86 of substantially the T-shaped cross-section, as shown in Figs.12a or 12b, or as control recesses 88 or control projections 89 of substantially the Y-shaped cross-section, as shown in Figs.13a or 13b.

[0073] With the first battery pack 5 and the first battery loading device 6, described above, the control recesses 28, 29 and the control projections 65, 66, mating with each other, are of the same profile. Alternatively, the control projections may also be shaped to be engaged in portions of the groove constituting a substantially cross-shaped control recess 91, as shown in Figs.14a to 14d. For example, plural control projections 92 to 94 may be set so as to be engaged in the control recess 91, as shown in Figs.14a to 14d. That is, the battery pack having the control recess 91 can be loaded on two sorts of the battery loading device, that is on the battery loading devices having the control projections 92 to 94.

[0074] Alternatively, control projections engaged with portions of the substantially T-shaped control recess 96, as shown in Figs. 15a to 15c, may also be used. The control recess 96 may be formed with plural control projections that may be engaged by control projections 97, 98, as shown in Figs.15a to 15c. That is, the battery pack having the control recess 96 may be loaded on two sorts of the battery loading device having the control projection 97 or 98.

[0075] In the above-described first battery pack 5 and the first battery loading device 6, the control recesses 28, 29 and the control projections 65, 66 are formed line-symmetrically with respect to substantially the centerline in the width-wise direction of the bottom surface 24. Of course, these recesses or projections may also be formed to the same profile substantially on either sides of the width-wise centerline of the bottom surface 24.

[0076] With the battery loading device according to the present invention, in which the state of tilt in the width-wise direction of the first battery pack 5 relative to the setting surface 45 of the loading section 43 of the first battery loading device 6 can be controlled positively, the bottom surface 24 of the first battery pack 5 can be positively prohibited from being intruded with a tilt in the width-wise direction relative to the setting surface 45 of the loading section 43. Thus, with the present battery loading device, it is possible to prevent possible destruction of the output terminals 21 to 23 and the connection terminals 51 to 53 of the first battery pack 5 and the first battery loading device 6.

[0077] Referring to the drawings, modifications of the battery pack and the battery loading device according to the present invention will be explained in detail. Meanwhile, in the following description of the modifications of the battery pack and the battery loading device, parts or components which are the same as those of the first embodiment are depicted by the same reference symbols and are not explained specifically.

[0078] Referring to Fig.16, the second battery pack 7 is of the standard charging capacity, and is of a thickness smaller than the first battery pack 5.

[0079] The second battery pack 7 includes a casing 101, housing a battery cell in its inside, and first to third output terminals 105 to 107 provided on a front surface 103 of the casing 101 and which are connected to the battery cell. The casing 101 is formed with guide grooves 109, 109 for guiding the intruding direction into the battery loading device, as shown in Fig.16.

[0080] In the front surface 103 of the casing 101 of the second battery pack 7, there are formed control recesses 111, 112 for controlling the state of tilt of the bottom surface 104 in the width-wise direction relative to the battery loading device, as shown in Fig.16.

[0081] At a mid portion of the bottom surface 104 of the casing 101 of the second battery pack 7, there is formed a discrimination recess 113 for discriminating whether or not the battery loading device for loading is an appropriate one, as shown in Fig.16. In the bottom surface of the discrimination recess 113 is formed a substantially rectangular groove 115 on substantially the centerline in the width-wise direction of the casing 101, whilst a step is formed on each side in the width-wise direction of the bottom surface 104. This discrimination recess 113 has a width W_0 along the width of the bottom surface 104.

[0082] In the discrimination recess 113, essential to the second battery pack 7, there is formed as one a discrimination lug 116 projected parallel to the longitudinal direction from the opening edge of the recess 113 parallel to the front surface 103.

[0083] In the bottom surface 104 of the casing 101, there are formed a first guide groove 118 and a second guide groove 119, adjacent to the third output terminal 107, for guiding the loading direction to the battery loading device, as shown in Fig.16. In both lateral sides in the width-wise direction of the casing 101 are formed control grooves 120, 120 for controlling the tilt in the width-wise direction of the bottom surface 104 relative to the battery loading device so that the grooves 120, 120 are opened in the front surface 103 and are substantially parallel to the bottom surface 104.

[0084] In the bottom surface 104 of the casing 101 are formed a first lock recess 121 and a second lock recess 122 which are engaged by the battery loading device when the casing 101 is loaded thereon, as shown in Fig.16.

[0085] A third battery pack 9 is of a low charging capacity, and is of a smaller thickness than the second battery pack 7, as the standard type battery pack, as shown in Fig.17.

[0086] The third battery pack 9 includes a casing 124, housing a battery cell therein, and first to third output terminals 128 to 130, provided on a front surface 126 of the casing 124 and which is connected to the battery cell. In both lateral sides in the width-wise direction of the casing 124 are formed guide grooves 132, 132 for guiding the loading direction of the casing relative to the battery loading device.

[0087] In the front surface 126 of the casing 124 of the third battery pack 9, there are formed control recesses 134, 135, symmetrically relative to substantially the centerline in the width-wise direction, as shown in Fig.17, for controlling the state of tilt in the width-wise direction of the bottom surface 127 relative to the battery loading device when loading the casing on the appropriate battery loading device.

[0088] At a mid portion of the bottom surface 127 of the casing 124 of the third battery pack 9 is formed a discrimination recess 137, as shown in Fig.17, for discriminating whether or not the battery loading device is appropriate for the casing 124. In the bottom surface of the discrimination recess 137 is formed a discriminating groove 138, substantially rectangular in profile, substantially on the centerline in the width-wise direction of the casing 124. On both sides in the width-wise direction of the bottom surface 127 are formed steps. The discriminating recess 137 has a width W_0 parallel to the width-wise direction of the bottom surface 127.

[0089] In the discriminating recess 137, essential to the third battery pack 9, there is formed a discriminating lug 139 protruded on the opening edge parallel to the front surface 126 in a direction parallel to the longitudinal direction of the casing 124. In the distal end in the longitudinal direction of the discriminating lug 139 is formed a discriminating recess 140.

[0090] The casing 124 is formed with a first guide groove 142 and a third guide groove 143, adjacent to the third output terminal 130, for guiding the loading of the casing relative to the battery loading device. In both lateral sides along the width of the casing 124 are formed control grooves 144, 144 for controlling the tilt in the width-wise direction of the bottom surface 127 relative to the battery loading device, so that the control grooves 144, 144 are opened on the front surface 126 and are substantially parallel to the bottom surface 127.

[0091] In the bottom surface 127 of the casing 124 are also formed a first lock recess 146 and a second lock recess 147 which are engaged by the battery loading device when the casing is loaded thereon, as shown in Fig.17.

[0092] A battery plate used for connection to a further external power source, such as an AC power source for household use, is now explained by referring to the drawings. Referring to Figs.18 and 19, the battery plate 11 is of a substantially rectangular plate shape and includes a connection terminal section 148 for connection to a variety of external power sources, a casing 149 provided with the connection terminal section 148 and first to third output terminals 153 to 155 connected to the connection terminal section 148.

[0093] The connection terminal section 148 includes a wiring cord for connection to an AC adapter, not shown. In both lateral sides in the width-wise direction of the casing 149 are formed guide grooves 157 for guiding the casing as it is loaded on the battery loading device, as shown in Figs.18 and 19.

[0094] In a front surface 150 of the casing 149 of the battery plate 11, there are formed control recesses 160, 161 symmetrically relative to substantially the centerline in the width-wise direction thereof, as shown in Fig.19. The control recesses 160, 160 are used for controlling the state of tilt in the width-wise direction of the bottom surface 151 relative to the battery loading device when loading the casing on the appropriate battery loading device.

[0095] At a mid portion of the bottom surface 151 of the casing 149 of the battery plate 11, there is formed a discriminating recess 163 for discriminating whether the casing is appropriate for the battery loading device for loading. In the bottom surface of the discriminating recess 163 is formed a substantially rectangular discriminating groove 165 on substantially the centerline in the width-wise direction of the casing 149. On one side in the width-wise direction of the bottom surface 151 is formed a step. The discriminating recess 163 has a size W_2 parallel to the width of the bottom surface 151 smaller than the width W_0 of each of the discriminating recesses 30, 113, 137 of the above-described battery packs 5, 7, 9.

[0096] In the bottom surface 151 of the casing 149 are formed a first guide groove 167 and a second guide groove 168, adjacent to the third output terminal 155, for guiding the casing as it is loaded on the battery loading device, as shown in Fig.19. The first guide groove 167, which is planar and contiguous to the step in the discriminating recess 163, has a profile different from that of the first guide grooves 30, 113, 137 of the above-described battery packs 5, 7, 9.

[0097] In both lateral sides in the width-wise direction of the casing 149 are formed control grooves 169, 169 for controlling the tilt in the width-wise direction of the bottom surface 151 relative to the battery loading device so that the control grooves are opened on the front surface 150 and are substantially parallel to the bottom surface 151.

[0098] In the bottom surface 151 of the casing 149 are formed a first lock recess 171 and a second lock recess 172, engaged by the battery loading device on loading the casing thereon, as shown in Fig.19.

[0099] The battery plate 11, constructed as described above, is loaded on an appropriate battery loading device, and is connected via an AC adapter to an external power source or a large-sized battery, to supply the power from an external power source directly to the main body portion of the device.

[0100] A fourth battery pack 12 is configured sub-

stantially similarly to the first battery pack 5, and has a bottom surface 177 of the casing 175 of a longitudinal size smaller than the first battery pack 5. Referring to Figs.20 and 21, this front surface side of the fourth battery pack 12 has a longitudinal length smaller than that of the first battery pack 5 shown in Figs.2 and 3, as indicated by a broken line shown in Fig.2.

[0101] This fourth battery pack 12 has a casing 175, housing therein the battery cell, and first to third output terminals 181 to 183, which are provided on the front surface 176 of the casing 175 and which are connected to the battery cell. On both lateral sides in the width-wise direction of the casing 175 are formed guide grooves 185 for guiding the casing 175 as it is loaded on the battery loading device, as shown in Figs.20 and 21.

[0102] In the front surface 176 of the casing 175 of the second battery pack 12 are formed control recesses 187, 188 for controlling the state of tilt in the width-wise direction of the bottom surface 177 relative to the battery loading device when loading the casing on the appropriate battery loading device. The control recesses 187, 188 are of substantially T-shaped cross-section and of substantially L-shaped cross-section, respectively.

[0103] In a mid portion of the bottom surface 177 of the casing 175 of the fourth battery pack 12, there is formed a discriminating recess 190 for discriminating whether or not the battery loading device for loading is appropriate for the casing 175, as shown in Fig.21. In the bottom surface of the discriminating recess 190 is formed a substantially rectangular discriminating groove 191, substantially on the centerline in the width-wise direction of the casing 175. On both sides in the width-wise direction of the bottom surface are formed steps. The discriminating recess 190 has a width W_0 parallel to the width of the bottom surface 177.

[0104] Adjacent to the third output terminal 183 on the bottom surface 177 of the casing 175, there are formed a first guide groove 193 and a second guide groove 194 for guiding the casing as it is loaded on the battery loading device. In the bottom surface 177 of the casing 175 is formed a discriminating groove 195 adjacent to the first guide groove 193 for discrimination from the first battery pack 5. In both lateral sides in the width-wise direction of the casing 175 are formed control grooves 196, 196 for controlling the tilt in the width-wise direction of the bottom surface 177 relative to the battery loading device, so that the grooves 196, 196 are opened in the front surface 176 and are extended substantially parallel to the bottom surface 177.

[0105] In the bottom surface 177 of the casing 175, there are formed a first lock recess 197 and a second lock recess 198 engaged by the battery loading device on loading the casing on the battery loading device, as shown in Fig.21. The second lock recess 198 is formed so that it is opened on the back surface of the casing 175.

[0106] A second battery loading device 8, on which can be loaded the above-described first to fourth battery packs 5, 7, 9 and 12, is now explained by referring to the drawings.

[0107] Referring to Fig.22, the second battery loading device 8 includes a loading section 201, having a setting surface 204 on which to set the battery packs 5, 7, 9 and 12, and a terminal section 202 to which are connected output terminals 21, 22, 23, 105, 106, 107, 128, 129, 130, 181, 182 and 183 of the battery packs 5, 7, 9 and 12.

[0108] On both lateral sides in the width-wise direction of the setting surface 204 of the loading section 201, there are formed guide projections 207 engaging in the guide grooves 26, 109, 132, 185 of the battery packs 5, 7, 9, 12 in adjacency to the setting surface 204, as shown in Fig.22.

[0109] The terminal section 202 is provided on an abutment surface 205 of the battery loading device facing the front surfaces 20, 103, 126, 176 of the battery packs 5, 7, 9 and 12, loaded thereon, as shown in Fig.22. The terminal section 202 is provided with first, second and third connection terminals 211, 212 and 213, to which are connected the output terminals 21 to 23, 105 to 107, 128 to 130 and 181 to 183 of the battery packs 5, 7, 9 and 12. On the terminal section 202, a cover member 215 for protecting the connection terminals 211 to 213 is mounted for rotation with respect to the loading section 201, as shown in Fig.22.

[0110] The loading section 201 of the first battery loading device 8 is formed as one with a pair of control projections 217, 218 line-symmetrically with respect to substantially the centerline in the width-wise direction of the setting surface 204, as shown in Fig.22. These control projections 217, 218 are provided astride the abutment surface 205 and the setting surface 204 so as to be engaged with the control recesses 28, 29, 111, 112, 134, 135, 187, 188 of the battery packs 5, 7, 9 and 12. These control projections 217, 218 are of a height level in a direction perpendicular to the setting surface 204 higher than the outer peripheral parts of the connection terminals 211 to 213 to prevent possible destruction of these connection terminals 211 to 213.

[0111] The loading section 201 of the second battery loading device 8 is formed as one with a first guide projection 220 adapted for guiding the battery packs 5, 7, 9 and 12. The first guide projection 220 is provided astride the abutment surface 205 and the setting surface 204, in adjacency to the third connection terminal 213 for extending parallel to the longitudinal direction of the setting surface 204. On the first guide projection 220 is formed a step, projected in a direction perpendicular to the setting surface 204, in continuation to the abutment surface 205. This step has a height level in a direction perpendicular to the setting surface 204 slightly higher than the control projections 217, 218 to prevent possible destruction of these connection terminals 211 to 213.

[0112] The loading section 201 of the second bat-

tery loading device 8 is formed as one with a second guide projection 222, astride the setting surface 204 and the abutment surface 205, for guiding the loading direction of the battery packs 5, 7, 9, 12, as shown in Fig.22. The loading section 201 of the second battery loading device 8 is also formed on both lateral sides in the width-wise direction thereof as one with control pawls 224, 224 engaging in the control grooves 37, 120, 132 and 196 of the battery packs 5, 7, 9 and 12. The control pawls 224, 224 are parallel to the setting surface 204, while being parallel to the longitudinal direction of the setting surface 204. At a mid portion of the setting surface 204 of the loading section 201 of the second battery loading device 8 is integrally formed a discriminating projection 226 engaging in the discriminating recesses 30, 113, 137, 190 of the battery packs 5, 7, 9 and 12.

[0113] The discriminating projection 226 is of a width W_3 parallel to the width of the setting surface 204 larger than the width W_1 of the discriminating projection 73 of the first battery loading device 6, as shown in Fig.22. This discriminating projection 226 is slightly smaller than the width W_0 of the discriminating recesses 30, 113, 137, 190 of the battery packs 5, 7, 9 and 12 and hence can be intruded into the discriminating recesses 30, 113, 137, 190. The discriminating projection 226 is formed at a position spaced a distance L_2 larger than the distance L_1 of the discriminating projection 73 of the first battery loading device 6 in a direction perpendicular to the abutment surface 205, as shown in Fig.22.

[0114] The loading section 201 of the second battery loading device 8 is provided with a lock mechanism 228 for holding the loaded battery packs 5, 7, 9 and 12. The lock mechanism 228 includes a lock member 230, having a lock pawl 232 for engaging with lock holes 38, 121, 146, 197 of the battery packs 5, 7, 9 and 12, and an operating lever 231 for actuating this lock member 230. The lock pawl 232 is movably passed through an opening 234 formed in the setting surface 204.

[0115] If the first to fourth battery packs 5, 7, 9 and 12 are loaded on the above-described second battery loading device 8, the battery packs are verified to be appropriate and loaded if the discriminating projection 226 is passed through the discriminating recesses 30, 113, 137, 190. If the battery plate 11, verified to be inappropriate, is loaded on the second battery loading device 8, the step of the first guide projection compresses against the planar surface of the first guide groove 167 of the battery plate 11 to render intrusion of the battery plate 11 impossible. Also, since the width W_2 of the discriminating recess 163 of the battery plate 11 is smaller than the width W_3 of the discriminating projection 226, the discriminating projection 226 cannot be intruded into the discriminating recess 163 so that the battery plate 11 is verified to be inappropriate to render the intrusion of the battery plate 11 impossible. Therefore, only the battery plate 11 is verified to be non-loadable on the second battery loading device 8.

[0116] A third battery loading device, on which can be loaded the battery packs 5, 7, 9 and 12 and the battery plate 11, is now explained by referring to the drawings.

[0117] Referring to Fig.23, the third battery loading device 10 includes a loading section 238, having a setting surface 241 on which to set the battery packs 5, 7, 9 and 12 and the battery plate 11, and a terminal section 239, to which are connected the battery packs 5, 7, 9, 12 and the output terminals 21 to 23, 105 to 107, 128 to 130, 181 to 183 and 153 to 155.

[0118] On both width-wise lateral sides of the setting surface 241 of the loading section 239 are formed guide projections 244, adjacent to the setting surface 241, for engaging in the guide grooves 26, 109, 132, 185 and 157 of the battery packs 5, 7, 9, 12 and the battery plate 11, as shown in Fig.23.

[0119] The terminal section 239 is arranged on an abutment surface 242 facing the front surfaces 20, 103, 126 and 176 of the battery packs 5, 7, 9, 12 and the battery plate 11, and includes first, second and third connection terminals 246 to 248, to which are connected output terminals 21 to 23, 105 to 107, 128 to 130, 181 to 183 and 153 to 155 of the battery packs 5, 7, 9, 12 and the battery plate 11, as shown in Fig.23. In the terminal section 239, a cover member 250 for protecting the connection terminals 246 to 248 is arranged for rotation with respect to the loading section 239, as shown in Fig.23.

[0120] The loading section 238 of the third battery loading device 238 of the third battery loading device 10 is formed as one with a pair of control projections 252, 253 line-symmetrically with respect to substantially the width-wise centerline of the setting surface 241, as shown in Fig.23. The control projections 252, 253 are formed astride the abutment surface 242 and the setting surface 241 so as to be engaged in the control recesses 28, 29, 111, 112, 134, 135, 187, 188, 160, 161 of the battery packs 5, 7, 9, 12 and the battery plate 11. These control projections 252, 253 are of a height level in a direction perpendicular to the setting surface 241 slightly higher than the outer periphery of the connection terminals 246 to 248 to prevent destruction of the connection terminals 246 to 248.

[0121] The loading section 238 of the third battery loading device 10 is formed as one with a first guide projection 255, astride the setting surface 241 and the abutment surface 242, adjacent to the third connection terminal 248, for guiding the loading of the battery packs 5, 7, 9, 12 and the battery plate 11.

[0122] The loading section 239 of the third battery loading device 10 is formed as one with the second guide projection 256 for extending parallel to the longitudinal direction of the setting surface 241 astride the setting surface 241 and the abutment surface 241, as shown in Fig.23. The second guide projection 256 is adapted for guiding the loading direction of the battery

packs 5, 7, 9, 12 and the battery plate 11. On both lateral sides in the width-wise direction of the loading section 239 of the third battery loading device 10 are integrally formed control pawls 257, 257 engaging in control grooves 37, 120, 132, 196, 169 of the battery packs 5, 7, 9, 12 and the battery plate 11. The control pawls 257, 257 are formed parallel to the setting surface 241 and to the longitudinal direction of the setting surface 241. Meanwhile, there is not formed, at a mid portion of the setting surface 241 of the loading section 239 of the third battery loading device 10, a discriminating projection engaging in the discriminating recesses 30, 113, 137, 190, 163 of the battery packs 5, 7, 9, 12 and the battery plate 11. Thus, the battery packs 5, 7, 9, 12 and the battery plate 11 can be set on the setting surface 241 of the third battery loading device 10.

[0123] The loading section 239 of the third battery loading device 10 is provided with a lock mechanism 260 for holding the loaded battery packs 5, 7, 9, 12 and the battery plate 11. The lock mechanism 260 includes a lock member 262 having a lock pawl 264 engaging in first lock holes 38, 121, 146, 197, 171 formed in the battery packs 5, 7, 9, 12 and the battery plate 11, and an operating lever 263 for causing the movement of the lock member 262. The lock pawl 264 is movably passed through an opening 265 formed in the setting surface 241.

[0124] The above-described third battery loading device 10 is not formed with discriminating projections intruded into the discriminating recesses 30, 113, 137, 190, 163, so that, when the battery packs 5, 7, 9, 12 and the battery plate 11 are loaded thereon, these are loaded thereon as being appropriate. Moreover, since there is no step formed on the first guide projection 255 of the third battery loading device 10, it is intruded into the first guide groove 167 of the battery plate 11 so that the battery plate 11 is loaded as being appropriate.

[0125] A fourth battery loading device 13, on which can be loaded only the above-described fourth battery pack 12, is explained by referring to the drawings.

[0126] The fourth battery loading device 13 includes a loading section 268, having a setting surface 271 on which to set the fourth battery pack 12, and a terminal section 269 to which are connected the respective output terminals 181 to 183 of the fourth battery pack 12.

[0127] The loading section 268 is formed with guide projections 275, adjacent to both lateral sides in the width-wise direction of the setting surface 271, engaging in the respective guide grooves 185 of the fourth battery pack 12, as shown in Fig.24.

[0128] The terminal section 269 is provided on an abutment surface 272 facing the front surface 176 of the fourth battery pack 12, loaded thereon, and includes first to third connection terminals 277 to 279 to which are connected the output terminals 181 to 183 of the fourth battery pack 12, as shown in Fig.24. A cover member 282 for protecting the connection terminals 277 to 279 is rotationally mounted on the terminal section 269 for rotation relative to the loading section 268, as shown in Fig.24.

[0129] The loading section 268 of the fourth battery loading device 13 is formed as one with a pair of control projections 285, 286, astride the abutment surface 272 and the setting surface 271, for engaging in the control recesses 187, 188 of the fourth battery pack 12, as shown in Fig.24. These control projections 285, 286 are of a height level in a direction perpendicular to the setting surface 271 higher than the outer periphery of the connection terminals 277 to 279 to prevent destruction of the connection terminals 277 to 279.

[0130] The loading section 268 of the fourth battery loading device 13 is formed with a first guide projection 288, astride the abutment surface 272 and the setting surface 271, adjacent to the third connection terminal 279, for guiding the loading of the fourth battery pack 12 in a direction parallel to the longitudinal direction of the setting surface 271. The first guide projection 288 is formed with a step in continuation to the abutment surface 272 for extending in a direction perpendicular to the setting surface 271. This step has a height level slightly higher than the control projections 285, 286 to prevent possible destruction of the connection terminals 277 to 279.

[0131] On both lateral sides in the width-wise direction of the loading section 268 of the fourth battery loading device 13, there are integrally formed control pawls 290, 290 engaging in the control grooves 196, 196 of the fourth battery pack 12. The control pawls 290, 290 are parallel to the setting surface 271 and to the longitudinal direction of the setting surface 271. At a mid portion of the setting surface 271, the loading section 268 of the fourth battery loading device 13 is formed as one with a discriminating projection 291 engaging in a discriminating recess 190 of the fourth battery pack 12.

[0132] The discriminating projection 291 has a width W_3 larger than the width W_1 of the discriminating projection 73 of the first battery loading device 6, as shown in Fig.24. The discriminating projection 291 is formed at a site spaced a distance L_2 larger than the distance L_1 of the discriminating projection 73 of the first battery loading device 6, as shown in Fig.24.

[0133] The loading section 268 of the fourth battery loading device 13 is provided with a lock mechanism 293 for holding the loaded fourth battery pack 12. The lock mechanism 293 includes a lock member 295 having a lock pawl 298 engaging in a lock hole 197 of the fourth battery pack 12, and an operating lever 296 for causing movement of the lock member 295. This lock pawl 298 is movably passed through an opening 299 formed in the setting surface 27.

[0134] If only the fourth battery pack 12 is loaded on the above-described fourth battery loading device 13, the discriminating projection 291 is intruded into the discriminating recess 190, whereby only the fourth battery pack 12 is verified to be appropriate and loaded.

[0135] If the first to third battery packs 5, 7 and 9 and the battery plate 11, verified to be inappropriate, are loaded erroneously, the control projection 286 compresses against the front surfaces 20, 103, 126, 150 of the casings 19, 101, 124, 149 to disable the intrusion of the battery packs 5, 7 and 9 or the battery plate 11, whereby the first to third battery packs 5, 7 and 9 and the battery plate 11 are verified to be inappropriate and cannot be loaded.

[0136] Finally, the first battery loading device 6 permits the loading only of the first battery pack 5 and the battery pack 11, whilst the second to fourth battery packs 7, 9, 12 are verified to be inappropriate. If the first battery pack 5 and the battery plate 11 are loaded on the first battery loading device 6, the discriminating projection 73 and the discrimination lug 74 are intruded into the discriminating recesses 30, 163, so that the first battery pack 5 and the battery plate 11 are verified to be appropriated and loaded.

[0137] If the second battery pack 7, verified to be inappropriate, is loaded on the first battery loading device 6, the discrimination lug 74 of the discriminating projection 73 abuts on the discriminating projection 116 of the discriminating recess 113 to demonstrate that it cannot be intruded. Therefore, the second battery pack 7 is verified to be inappropriate and non-loadable. If the third battery pack 9, verified to be inappropriate, is loaded on the first battery loading device 6, the discrimination lug 74 of the discriminating projection 73 abuts on the discriminating projection 139 of the discriminating recess 137 to demonstrate the non-loadability, so that the third battery pack 9 is verified to be inappropriate and non-intrudable.

[0138] The battery packs 5, 7, 9, 12 and the battery plate 11 are configured to be loaded on a variety of battery loading devices provided on the video camera apparatus 1. Alternatively, the battery packs 5, 7, 9, 12 and the battery plate 11 may be loaded on an illumination device mounted on the video camera apparatus 1. This illumination device, on which are loaded the battery packs 5, 7, 9, 12 and the battery plate 11, is now explained by referring to the drawings.

[0139] Referring to Figs.25 and 26, a first illumination device 15 includes an illumination unit 301 for illuminating an object, a changeover switch 302 for switching the operating state of the illumination unit 301, a loading unit 303 on which the first and second battery packs 5, 7 can be loaded and a terminal unit 304 to which are connected output terminals 21 to 23 and 105 to 107 of the battery packs 5 and 7.

[0140] The loading unit 303 is provided with guide projections 309 engaged with guide grooves 26, 109 of the battery packs 5, 7, as shown in Fig.26. The guide projections 309 are provided on both lateral sides in the width-wise direction of the setting surface 306 in adjacency to the setting surface 306.

[0141] The terminal unit 304 is provided on an abutment surface 307 facing the front surfaces 20, 103 of the loaded battery packs 5, 7, and includes first to third connection terminals 311 to 313 to which are connected output terminals of the battery packs 5, 7, as shown in Fig.26. A cover member 315 for protecting the connection terminals 311 to 313 is mounted for rotation relative to the loading unit 303, as shown in Fig.26.

[0142] The loading unit 303 of the first illumination device 15 is provided with a pair of control projections 316, 317, line-symmetrically relative to substantially the centerline in the width-wise direction of the setting surface 306, as shown in Fig.26. The control projections 316, 317 are formed as one with the loading unit 303 astride the abutment surface 307 and the setting surface 306 so as to be engaged with the control recesses 28, 29, 111, 112 of the battery packs 5, 7. The control projections 316, 317 are of a height level in a direction perpendicular to the setting surface 306 higher than the outer periphery of the connection terminals 311 to 313 to prevent destruction of the connection terminals 311 t o313.

[0143] The loading unit 303 of the first illumination device 15 is formed as-one with a first guide projection 319 for guiding the loading of the battery packs 5, 7 in a direction parallel to the longitudinal direction of the setting surface 306. The first guide projection 319 is formed astride the abutment surface 306 and the setting surface 307 in adjacency to the third connection terminal 313. A step projected in a direction perpendicular to the setting surface 306 is provided on the first guide projection 319 in continuation to the abutment surface 307. This step has a height level in a direction perpendicular to the setting surface 306 slightly higher than the control projections 316, 317 to prevent the destruction of the connection terminals 311 to 313.

[0144] The loading unit 303 of the first illumination device 15 is formed as one with a second guide projection 321 as one with the longitudinal direction of the setting surface 306, as shown in Fig.26. The second guide projection 321 is formed astride the setting surface 306 and the abutment surface 307 for guiding the loading of the battery packs 5, 7, as shown in Fig.26. The loading unit 303 of the first illumination device 15 is formed as one with control pawls 323, 323 on both width-wise lateral sides for engaging the control grooves 37, 120 of the battery packs 5, 7. The control pawls 323, 323 are parallel to the setting surface 306 and to the longitudinal direction of the setting surface 306. At a mid portion of the setting surface 306 of the loading unit 303 of the first illumination device 15 is integrally formed a discriminating projection 325 engaging in the discriminating recesses 30, 113 of the battery packs 30, 113 of the battery packs 5, 7. The distal end of the discriminating projection 325 is formed as one with the discriminating projection 326.

[0145] This discriminating projection 325 is of a width W_3 larger than the width W_1 of the discrimination projection 73 of the first battery loading device 6, as shown in Fig.26. The discriminating projection 325 is

formed at a position spaced a distance L_2 larger than the distance L_1 of the discriminating projection 73 of the battery loading device 6 in a direction perpendicular to the abutment surface 307, as shown in Fig.26.

[0146] The loading unit 303 of the first illumination device 15 is provided with a lock mechanism 328 for holding the loaded battery packs 5, 7. The lock mechanism 328 includes a lock member 330 having a lock pawl 332 engaging in the first lock holes 38, 121 of the battery packs 5, 7 and an operating lever 331 for causing the movement of the lock member 330. The lock pawl 332 is movably passed through the opening 333 formed in the setting surface 306.

[0147] If the first, second or fourth battery packs 5, 7, 12 are loaded on the loading unit 303 of the first illumination device 15, the discriminating projection 325 is intruded into the discriminating recesses 30, 113, 190 to demonstrate that the first, second and fourth battery packs are verified to be appropriate and loaded.

[0148] If the third battery pack 9, verified to be inappropriate, is erroneously loaded on the loading unit 303 of the first illumination device 15, the discriminating projection 326 of the discriminating projection 325 compresses against the discriminating recess 140 of the discriminating projection 139 in the discriminating recess 137 and demonstrates that it cannot be intruded. Thus, the third battery pack 9 is verified to be inappropriate and non-loadable.

[0149] If the battery plate 11, verified to be inappropriate, is erroneously loaded on the loading unit 303 of the first illumination device 15, the step on the first guide projection 319 abuts on the planar surface of the first guide groove 167 of the battery plate 11, and thus demonstrates that it cannot be intruded. Moreover, since the width W_2 of the discriminating recess 163 of the battery plate 11 is smaller than the width W_3 of the discriminating projection 325, the discriminating projection 325 cannot be intruded into the discriminating recess 163. Thus, the battery plate 11 is verified to be inappropriate and non-loadable.

[0150] Therefore, the loading unit 303 of the first illumination device 15 is configured so that the high capacity type first battery pack 5 and the standard type second and fourth battery packs 7, 12 can be loaded thereon. Since the illumination unit 301 of the first illumination device 15 consumes much power, the third battery pack 9 having a lower charging capacity and the battery plate 11 are verified to be inappropriate.

[0151] Referring to the drawings, a second illumination device 17, having a larger illumination volume than that of the above-described first illumination device 15, is now explained.

[0152] The second illumination device 17 includes an illumination unit 336 for illuminating an object, a changeover switch 337 for changing over the operating state of the illumination unit 336, a loading section 338 on which the first battery pack 5 is removably loaded, and a terminal unit 339 to which are connected the output terminals 21 to 23 of the first battery pack 5, as shown in Figs.27 and 28.

[0153] On both lateral sides in the width-wise direction of the setting surface 34, there are formed guide projections 344 engaged in the guide grooves 26 of the first battery pack 5 in adjacency to the setting surface 341, as shown in Fig.28.

[0154] On both width-wise lateral sides of the setting surface 341 of the loading section 338, there are formed guide projections 344, in adjacency to the setting surface 341, for engaging in the guide grooves 26 of the first battery pack 5, as shown in Fig.28.

[0155] The terminal unit 339 is arranged on the abutment surface 342 facing the front surface 20 of the loaded first battery pack 5, and includes first to third connection terminals 346 to 348 to which are connected the output terminals 21 to 23 of the first battery pack 5, as shown in Fig.28. The terminal unit 339 is also provided with a cover member 350 for protecting the connection terminals 346 to 348, so that the cover member will be rotated relative to the loading section 338, as shown in Fig.28.

[0156] The loading section 338 of the second illumination device 17 is formed as one with a pair of control projections 352, 353 line-symmetrically with respect to substantially the centerline in the width-wise direction of the setting surface 341. The control projections 352, 353 are formed astride the abutment surface 342 and the setting surface 341 so as to be engaged in the control recesses 28, 29 of the first battery pack 5, as shown in Fig.28. These control projections 352, 353 are of a height level in the direction perpendicular to the setting surface 341 higher than the outer periphery of the connection terminals 346 to 348 to prevent possible destruction of the connection terminals 346 to 348.

[0157] The loading section 338 of the second illumination device 17 is formed as one with a first guide projection 355 for guiding the loading of the first battery pack 5 parallel to the longitudinal direction of the setting surface 341. The first guide projection 355 is provided astride the abutment surface 342 and the setting surface 341 in adjacency to the third connection terminal 348. This first guide projection 355 is formed with a step protruded in a direction perpendicular to the setting surface 341 in continuation to the abutment surface 342. This step has a height level in a direction perpendicular to the setting surface 341 slightly higher than the control projections 352, 353 to prevent possible destruction of the connection terminals 346 to 348.

[0158] The loading section 338 of the second illumination device 17 is formed as one with a second guide projection 357 for extending parallel to the longitudinal direction of the setting surface 341. The second guide projection 357 is formed astride the setting surface 341 and the abutment surface 342 for guiding the loading of the first battery pack 5. On both width-wise lateral sides of the loading section 338 of the second illumination device 17 are protuberantly formed control pawls 358,

358 engaging in the control groove 37 of the first battery pack 5. The control grooves 358, 358 are parallel to the setting surface 341 and to the longitudinal direction of the first battery pack 5. At a mid portion of the setting surface 341 of the loading section 338 of the second illumination device 17 is integrally formed a discriminating projection 360 engaging in the discriminating recess 30 of the first battery pack 5. The distal end of the discriminating projection 360 is formed as one with a discriminating projection 361.

[0159] The discriminating projection 360 has a width W_3 larger than the width W_1 of the discrimination projection 73 of the first battery loading device 6. as shown in Fig.28. The discriminating projection 360 is formed at a position spaced a distance L_1 smaller than the distance L_2 of the discriminating projection 325 of the first illumination device 15 in a direction perpendicular to the abutment surface 342.

[0160] The loading section 338 of the second illumination device 17 is provided with a lock mechanism 363 for holding the loaded first battery pack 5. The lock mechanism 363 includes a lock member 364 having a lock pawl 366 engaging in the first lock hole 30 of the first battery pack 5, and an operating lever 365 for causing movement of the lock member 364. The lock pawl 366 is movably passed through an opening 368 formed in the setting surface 341.

[0161] If the first or second battery pack 5 or 12 is loaded on the loading section 338 of the above-described second illumination device 17, the discriminating projection 360 is intruded into the discriminating recesses 30, 190 to demonstrate that the first and second battery packs 5, 12 are appropriate for the loading section 338 to permit the battery pack 5 or 12 to be loaded in position.

[0162] If the second battery pack 7, verified to be inappropriate, is loaded on the loading section 338 of the second illumination device 17, the discriminating projection 361 of the discriminating projection 360 compresses against the discriminating projection 116 of the discriminating recess 113 to disable the intrusion. Thus, the second battery pack 7 is verified to be inappropriate and non-loadable. On the other hand, if the third battery pack 9, verified to be inappropriate, is loaded on the second illumination device 17, the discriminating projection 361 of the discriminating projection 360 compresses against the discriminating projection 139 of the discriminating recess 137 to disable the intrusion. Thus, the third battery pack 9 is verified to be inappropriate and non-loadable. Also, if the battery plate 11 verified to be inappropriate is loaded on the loading section 338 of the second illumination device 17, the step on the first guide projection 355 compresses against the planar surface of the first guide groove 167 to disable the intrusion. Moreover, since the width W_2 of the discriminating recess 163 of the battery plate 11 is smaller than the width W_3 of the discriminating projection 360, the discriminating projection 360 cannot be intruded into the discriminating recess 163. Thus, the battery plate 11 is verified to be inappropriate and non-loadable. Therefore, the high capacity type first and fourth battery packs 5, 12 can be loaded on the loading section 338 of the second illumination device 17.

[0163] With the battery loading mechanism according to the present invention, the discriminating recesses 30, 113, 137, 190 of the battery packs 5, 7, 9, 11, discriminating grooves 32, 115, 138, 191 in the discriminating recesses 30, 113, 137, 190, discriminating projections 116, 139, discriminating recess 140, discriminating projections 73, 226, 291, 325, 360 and the discriminating projections 74, 326 and 321 of these discriminating projections 73, 226, 291, 325, 360 are used for discrimination, so that it is possible to set various shapes conforming to plural specifications. Since it suffices in this battery loading mechanism to suitably modify only the shape of the discriminating recesses and the discriminating projections, it is unnecessary to manufacture new metal molds for different battery packs having different specifications to render it possible to curtail the manufacturing cost of metal molds.

[0164] It should be noted that, although the battery pack of the preferred embodiments includes a battery cell having a chargeable secondary battery, this is merely illustrative since the battery pack can be configured to exchangeably hold primary dry batteries. Moreover, although the battery loading device of the preferred embodiments is configured for loading on a video camera or an illumination device, it may also be mounted on electronic equipment, such as a charging device used for charging the battery pack.

Claims

1. A battery pack, comprising:

   a battery cell;
   a casing housing said battery cell, said casing including first and second surfaces arranged substantially at right angles;
   an output terminal arranged on said first surface for outputting the power of said battery cell; and
   a recess including a plurality of steps formed at a mid portion of said second surface.

2. The battery pack according to claim 1, wherein said recess includes an inner surface which extends substantially parallel to said first surface and is in use engaged by a projection on a battery loading device to which the battery pack is loaded.

3. The battery pack according to claim 1, wherein said recess includes an inner surface which extends substantially at right angles to said first surface and is in use engaged by a projection on a battery loading device to which the battery pack is loaded.

4. The battery pack according to claim 1, further comprising a first projection provided in said recess which protrudes in a direction substantially perpendicular to said first surface.

5. The battery pack according to claim 4, further comprising a stepped second projection provided upright on the distal end of said first projection which extends in a direction substantially perpendicular to said first surface.

6. The battery pack according to claim 1, wherein said battery cell includes a primary battery.

7. A battery loading device, comprising:

a connection terminal for connection to an output terminal of a power supply member;
a loading section on which said power supply member is loaded, wherein said loading section includes first and second surfaces arranged substantially at right angles, with said connection terminal being arranged on said first surface and said power supply member being set on said second surface; and
a projection including a plurality of steps formed on said second surface.

8. The battery loading device according to claim 7, wherein said projection includes an outer peripheral surface substantially parallel to said first surface which in use is engaged in a recess in said power supply member.

9. The battery loading device according to claim 7, wherein said projection includes an outer peripheral surface substantially perpendicular to said first surface which in use is engaged in a recess in said power supply member.

10. A power supply device for loading on a battery loading device, said power supply device comprising:

a connection terminal for connection to power supply means;
a casing housing said connection terminal, said casing including first and second adjacent continuous surfaces set substantially at right angles;
an output terminal arranged on said first surface for outputting the power supplied to said connection terminal; and
a recess including a plurality of steps formed substantially centrally of said second surface.

11. The power supply device according to claim 10, wherein said recess includes an inner surface which extends substantially parallel to said first surface and is in use engaged by a projection on said battery loading device.

12. The power supply device according to claim 10, wherein said recess includes an inner surface which extends substantially at right angles to said first surface and is in use engaged by a projection on said battery loading device.

13. The power supply device according to claim 10, further comprising a first projection provided in said recess which extends substantially at right angles to said first surface.

14. The power supply device according to claim 13, further comprising a stepped second projection formed in said recess at the distal end of said first projection which extends in a direction substantially at right angles to said first surface.

15. Electronic equipment having a battery loading mechanism, said battery loading mechanism including:

a connection terminal for connection to an output terminal of a power supply member;
a loading section on which said power supply member is loaded, wherein said loading section includes first and second surfaces arranged substantially at right angles, with said connection terminal being arranged on said first surface and said power supply member being set on said second surface; and
a projection including a plurality of steps formed at a mid portion of said second surface.

16. The electronic equipment according to claim 15, wherein said projection includes an outer peripheral surface substantially parallel to said first surface which is in use engaged in a recess in said power supply member.

17. The electronic equipment according to claim 15, wherein said projection includes an outer peripheral surface substantially perpendicular to said first surface which is in use engaged in a recess in said power supply member.

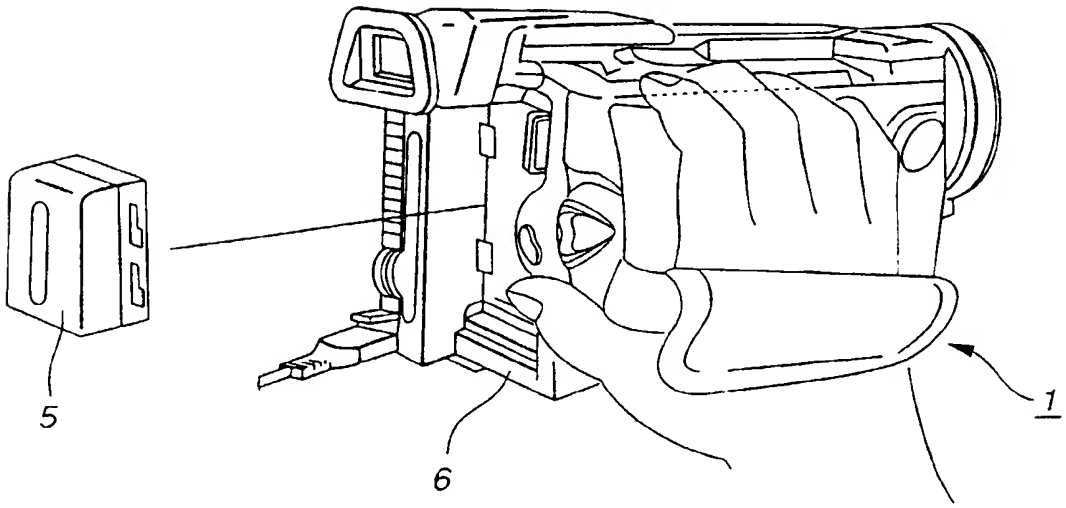


FIG.1

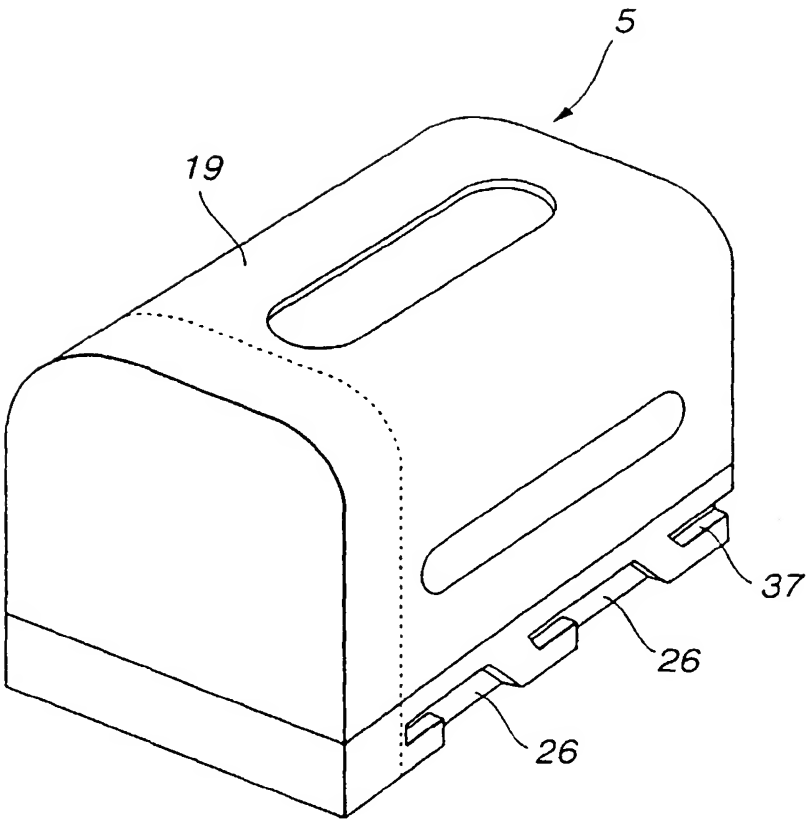


FIG.2

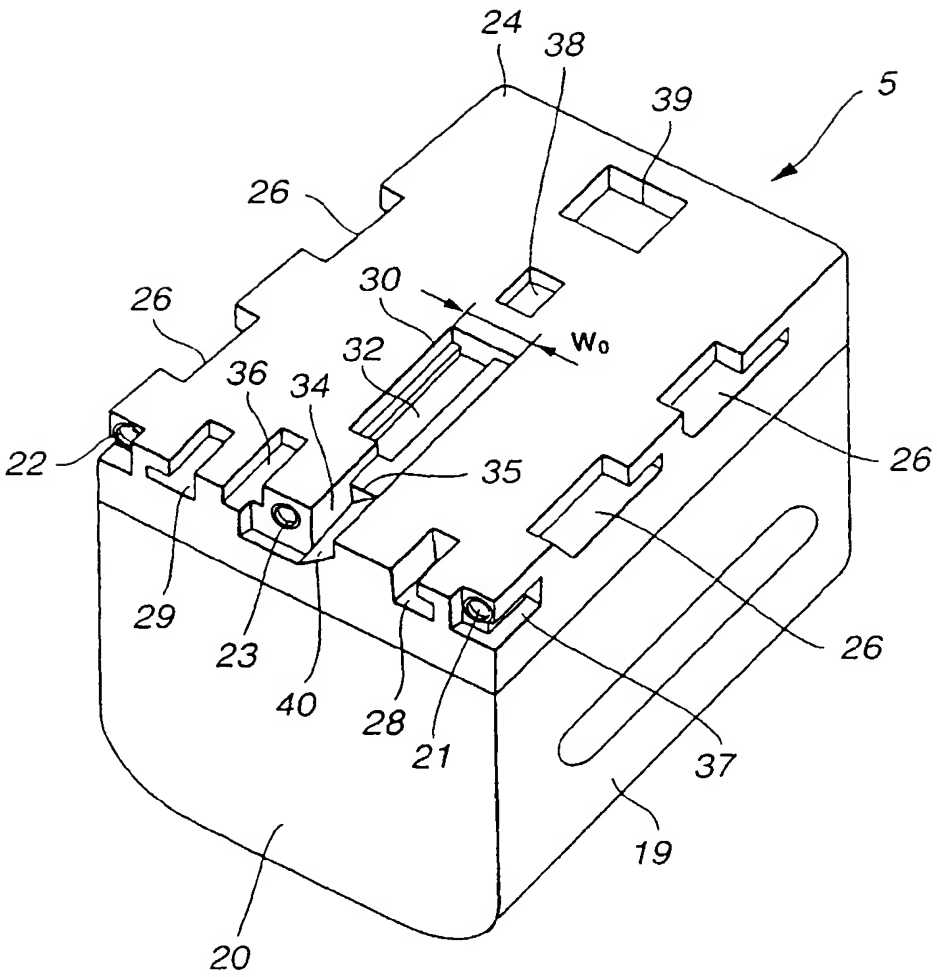


FIG.3

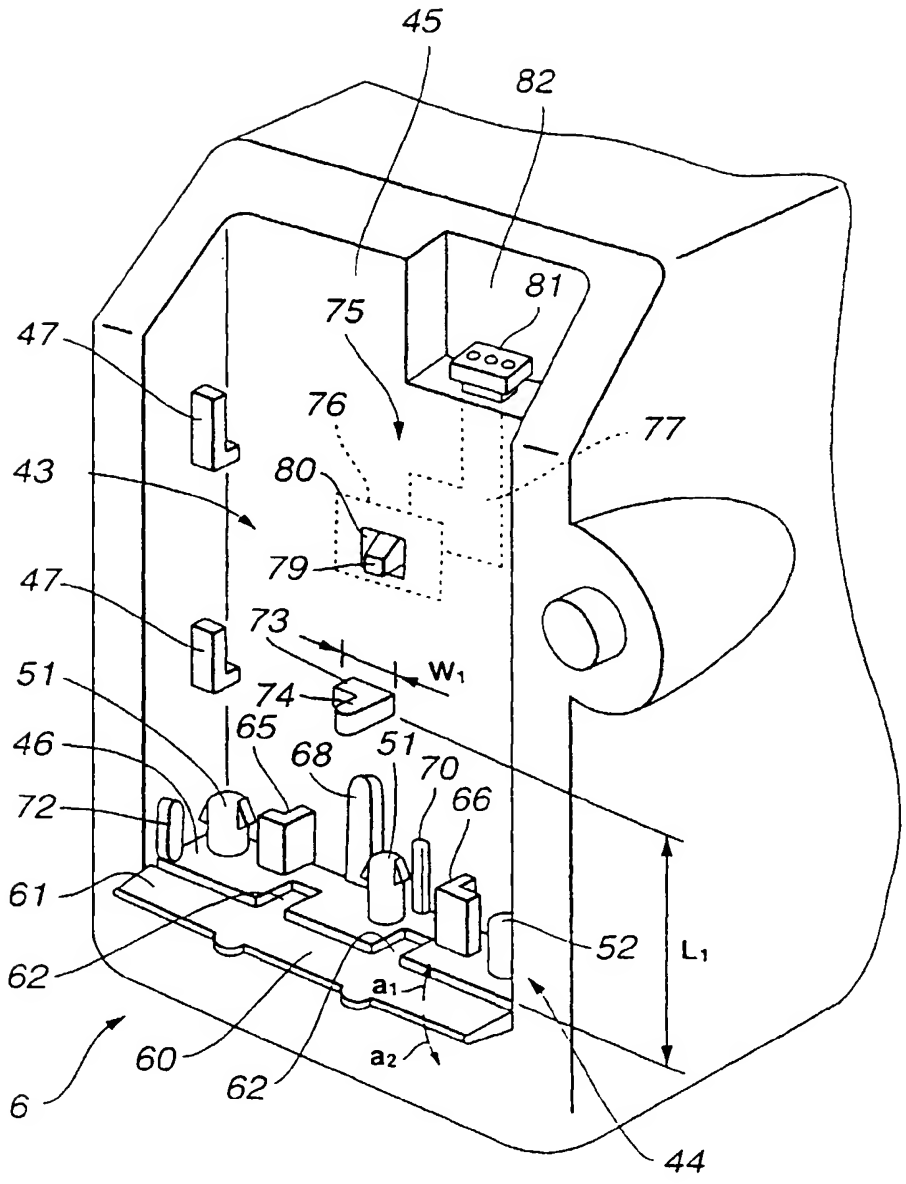


FIG.4

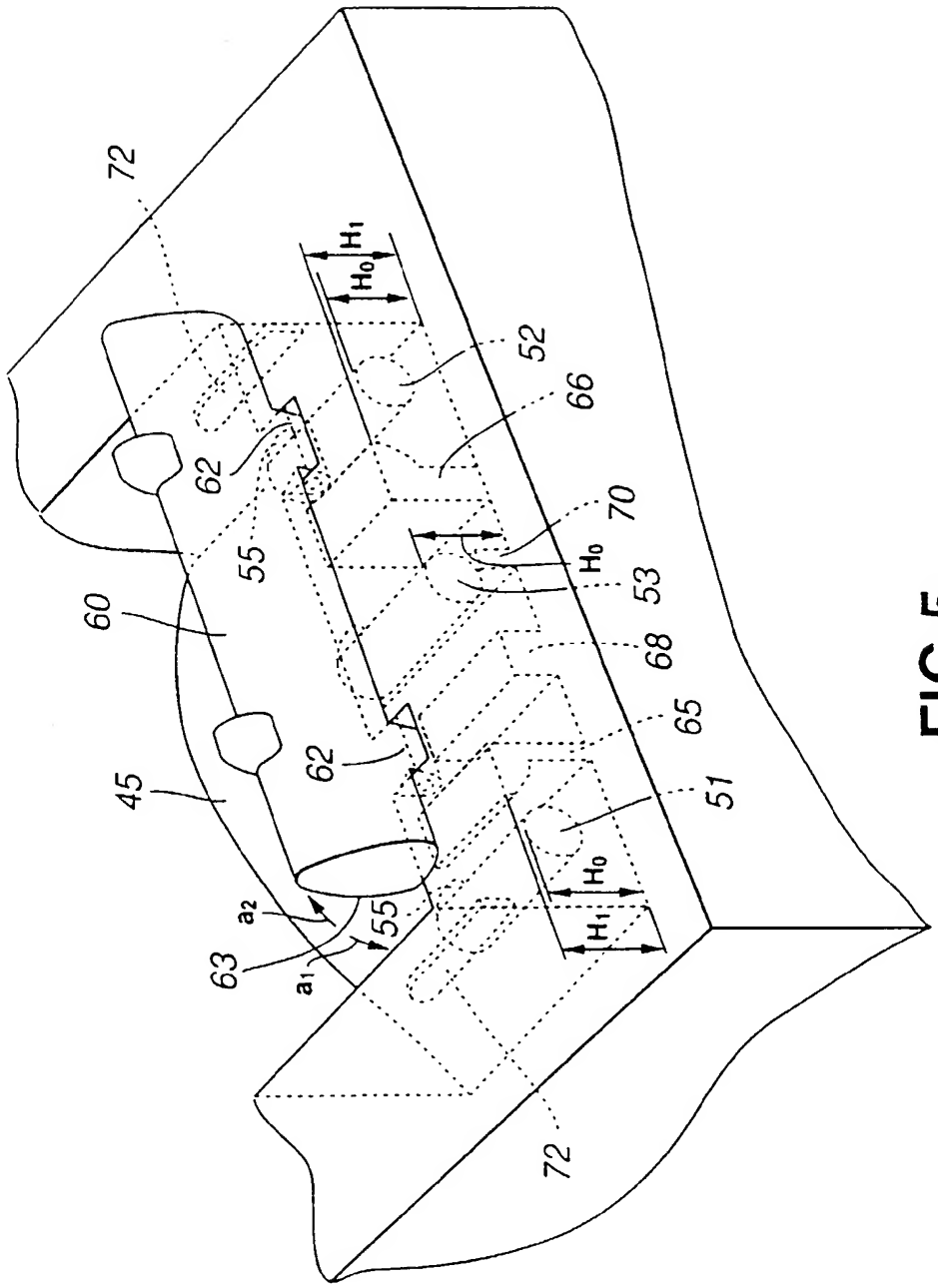


FIG.5

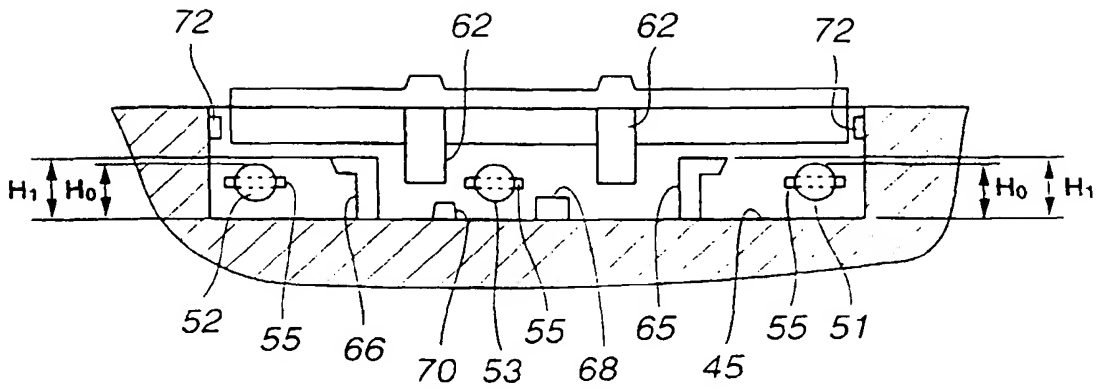


FIG.6

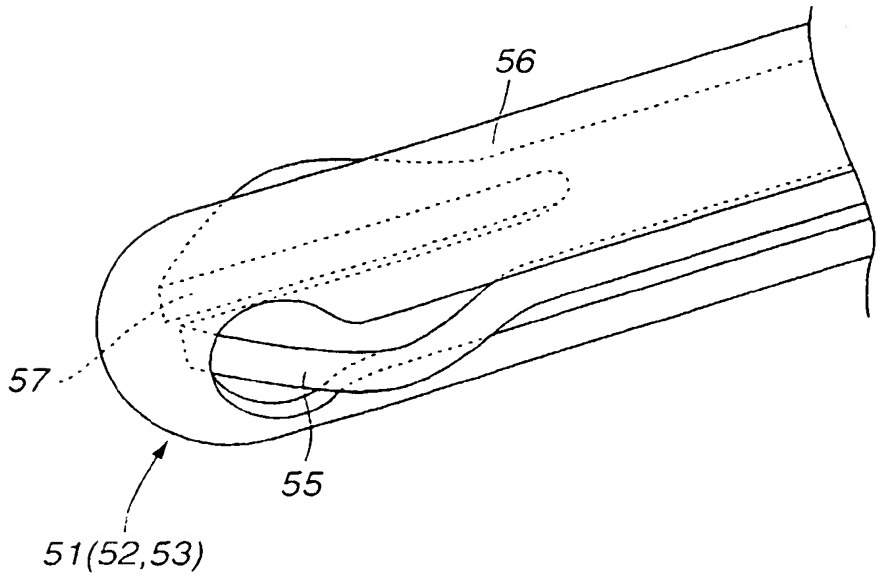


FIG.7

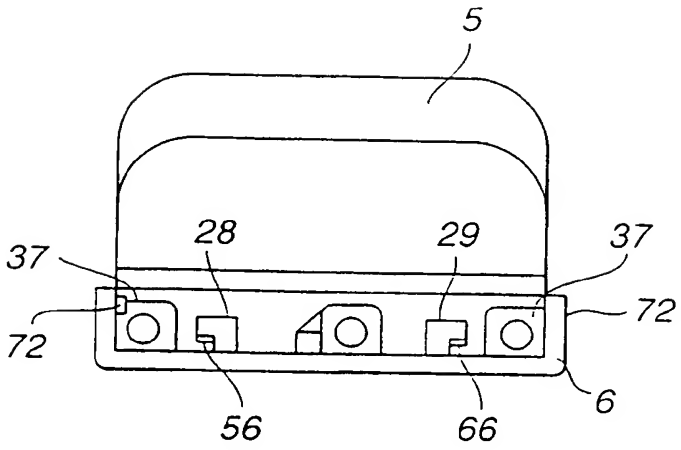


FIG.8

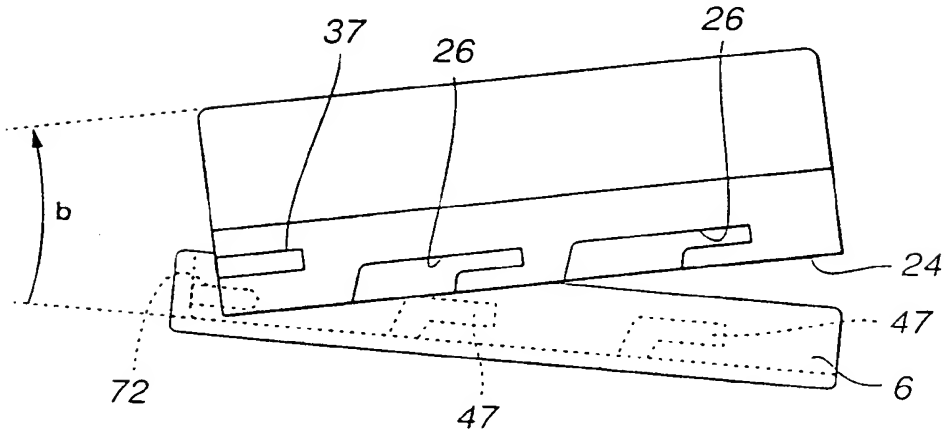


FIG.9

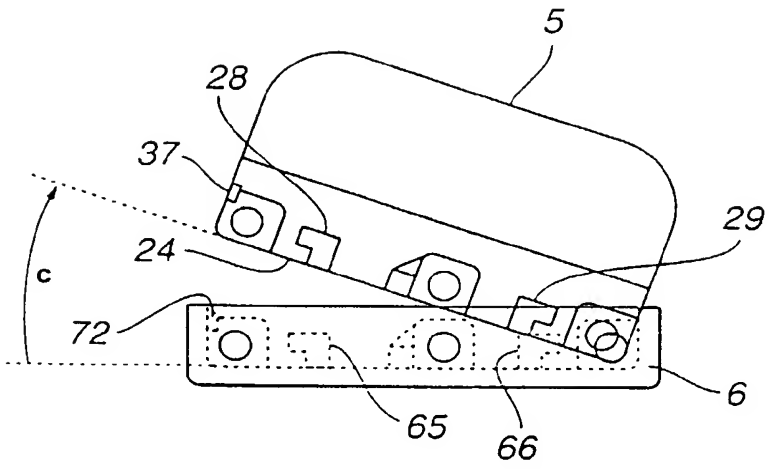


FIG.10

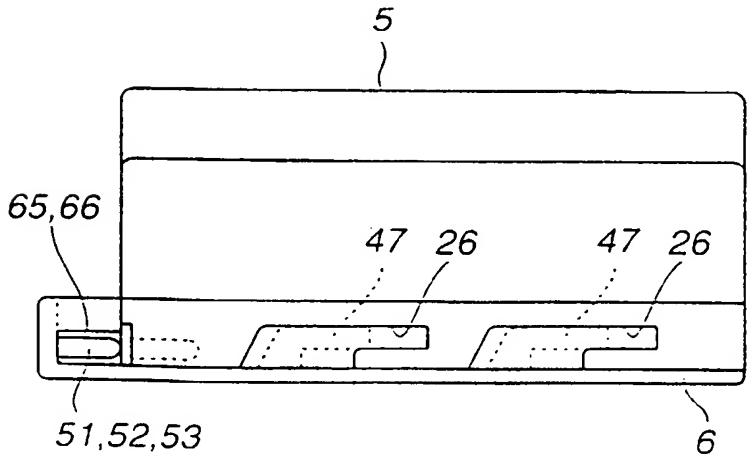


FIG.11

FIG.12A

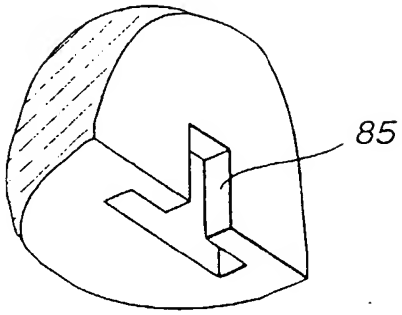


FIG.12B

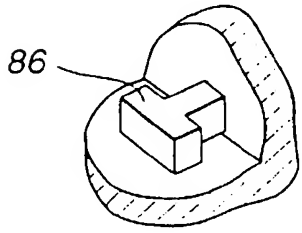


FIG.13A

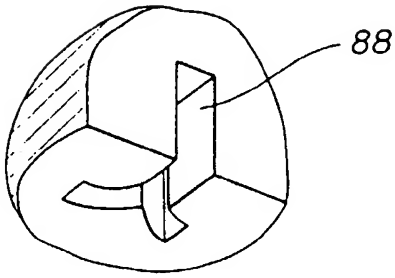
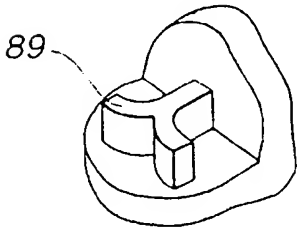


FIG.13B



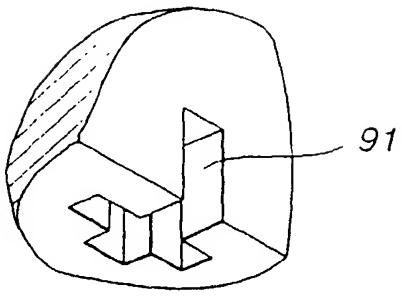


FIG.14A

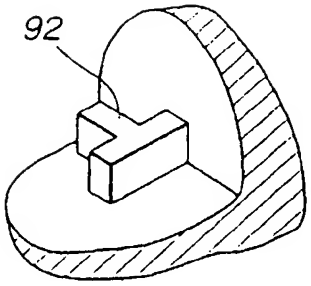


FIG.14B

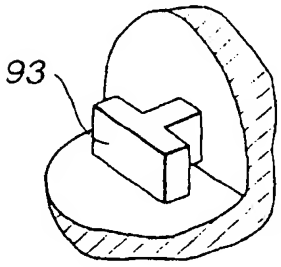


FIG.14C

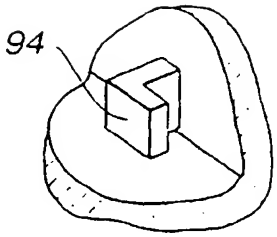


FIG.14D

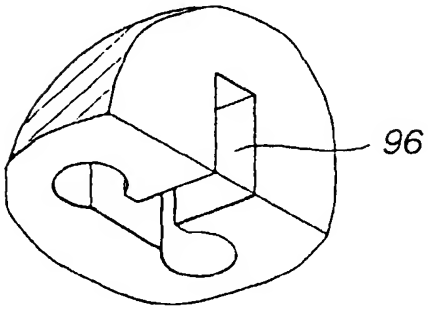


FIG.15A

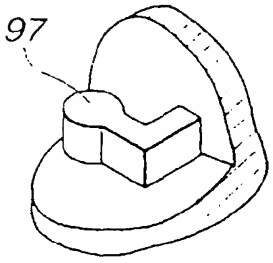


FIG.15B

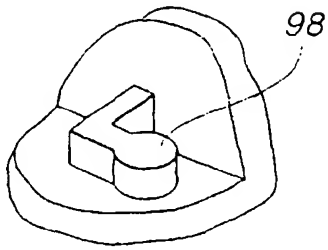


FIG.15C

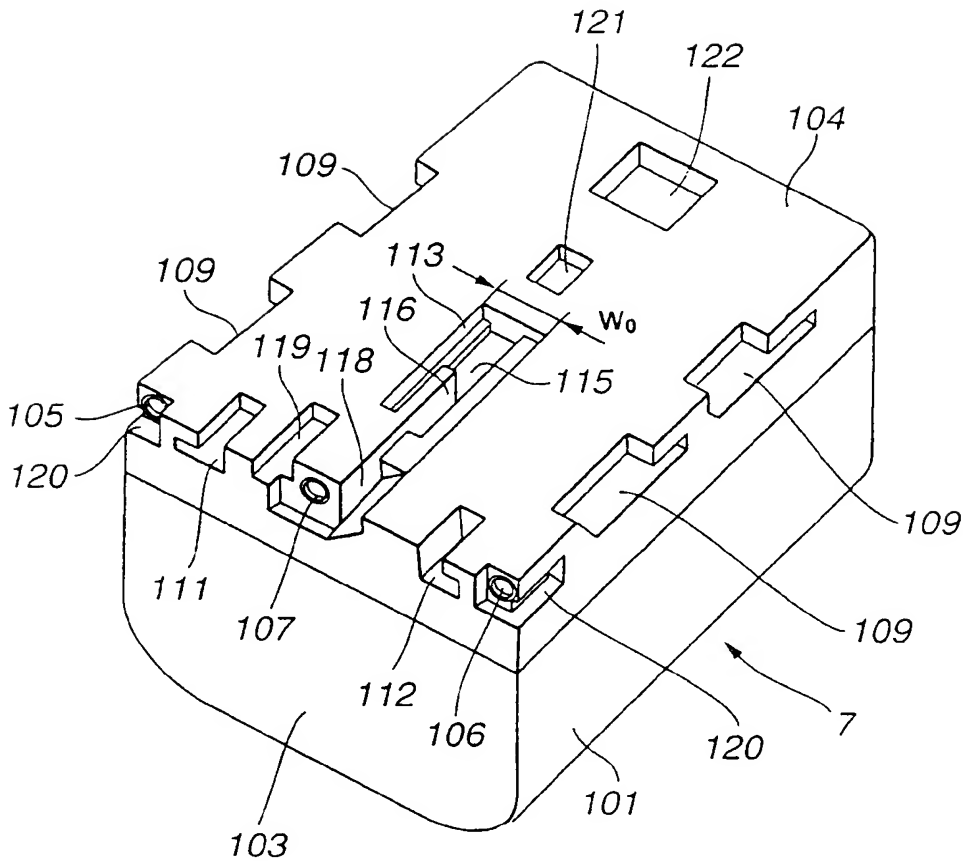


FIG.16

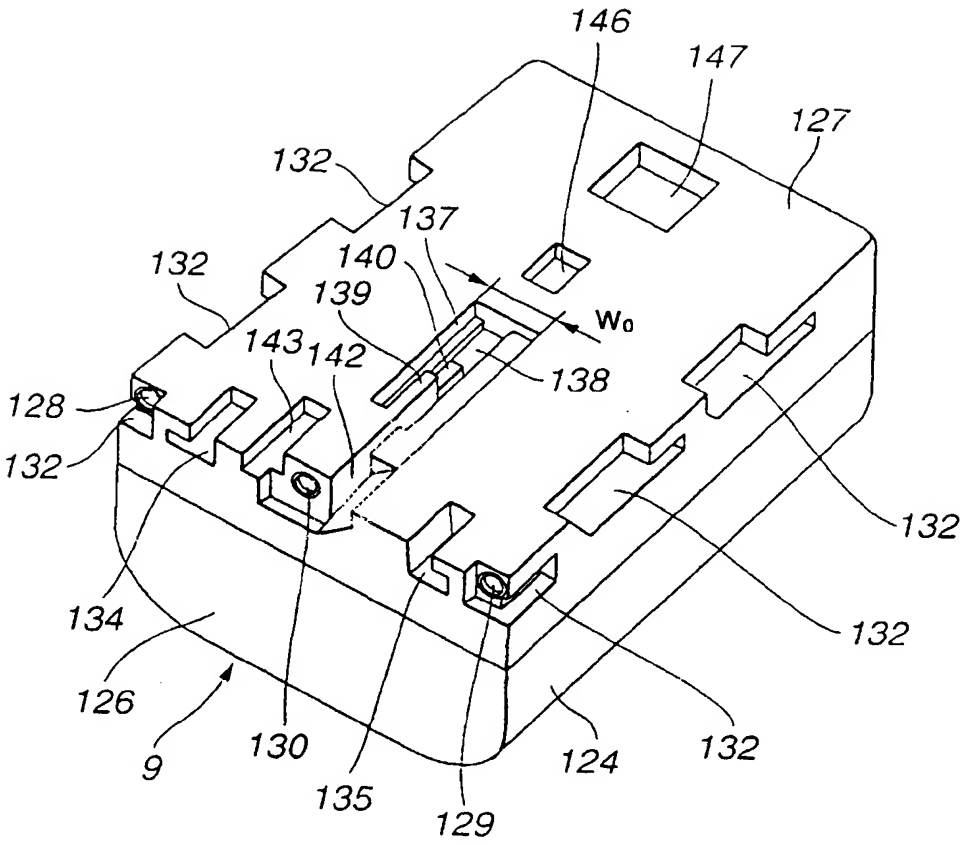


FIG.17

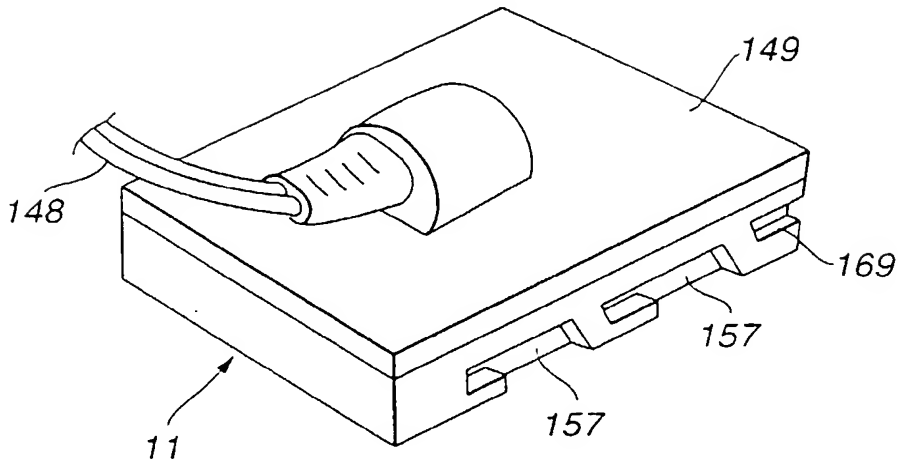


FIG.18

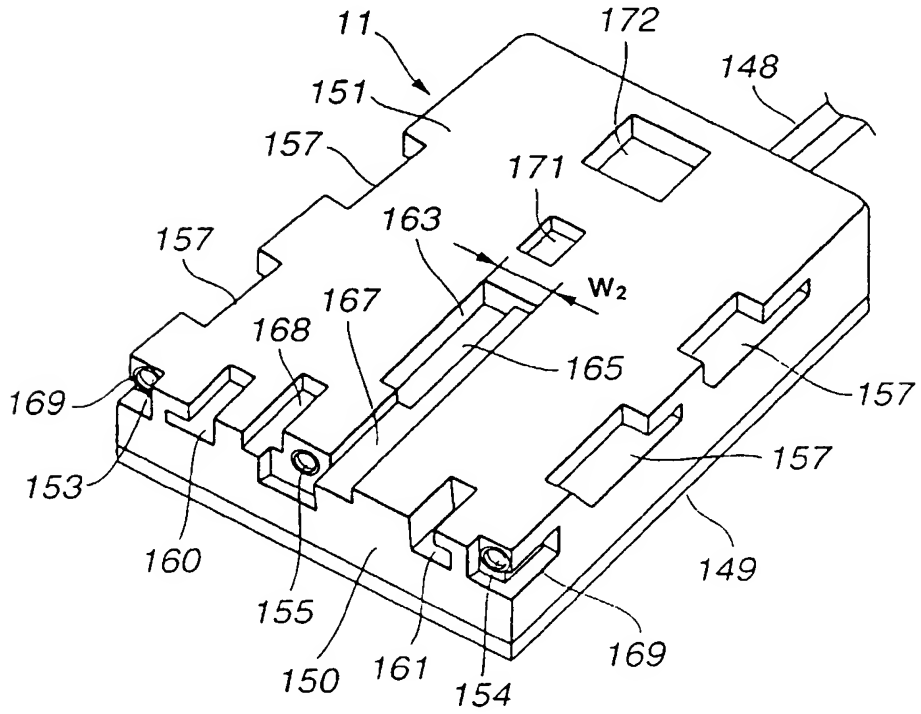


FIG.19

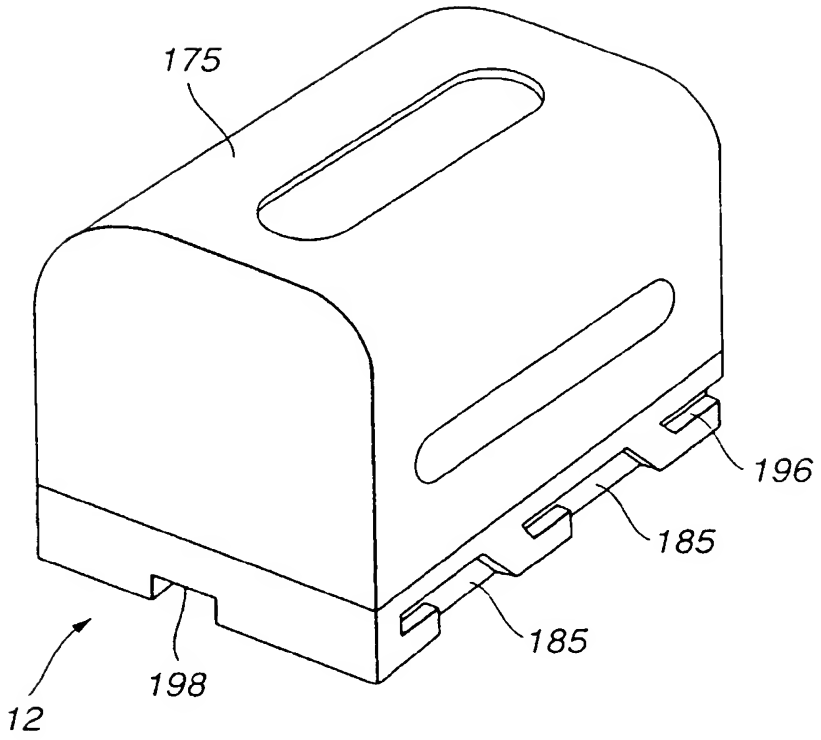


FIG.20

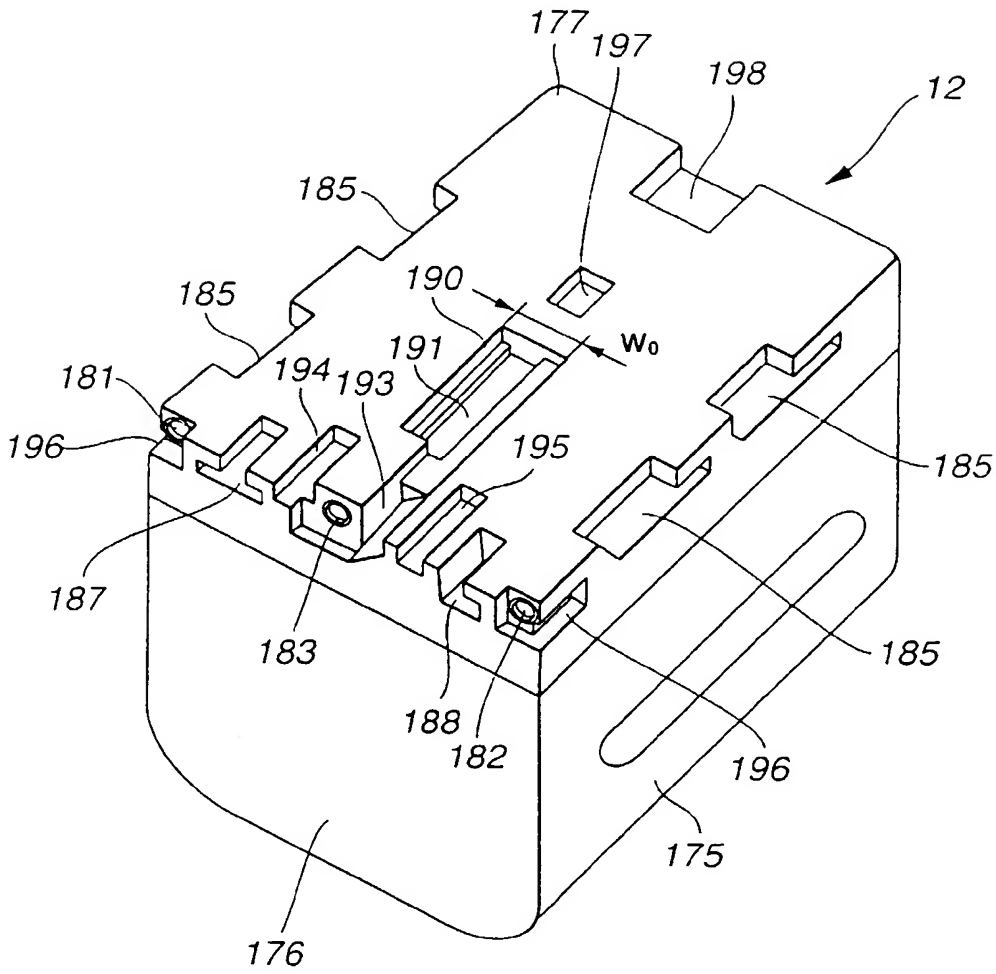


FIG.21

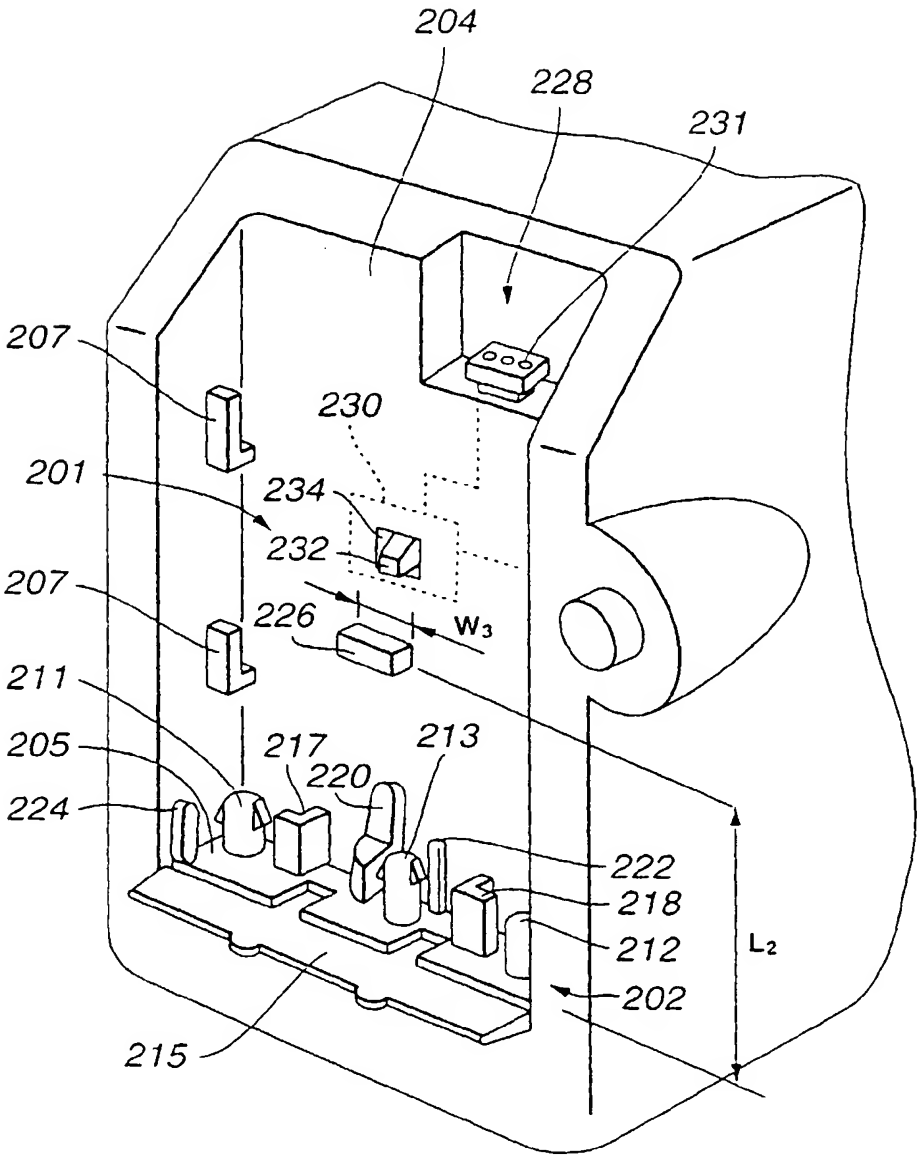


FIG.22

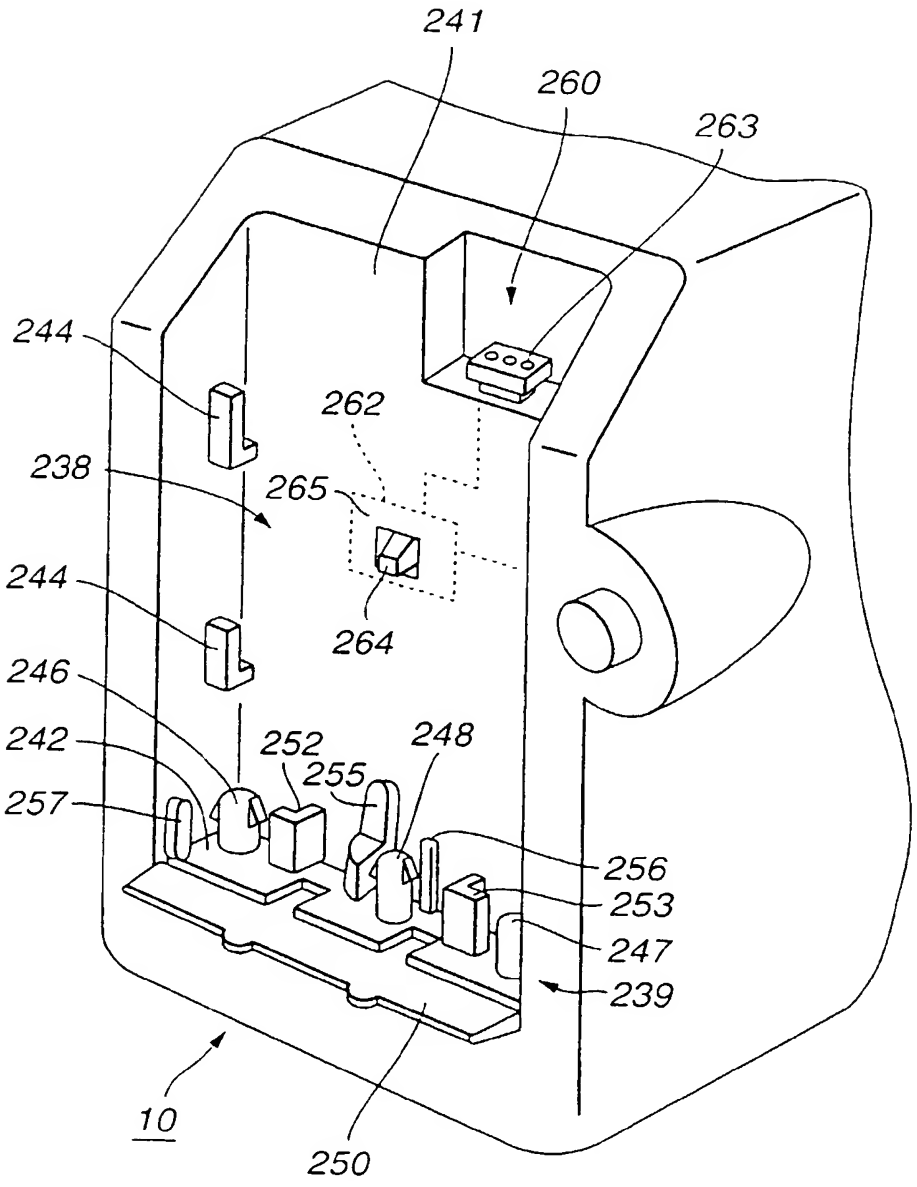


FIG.23

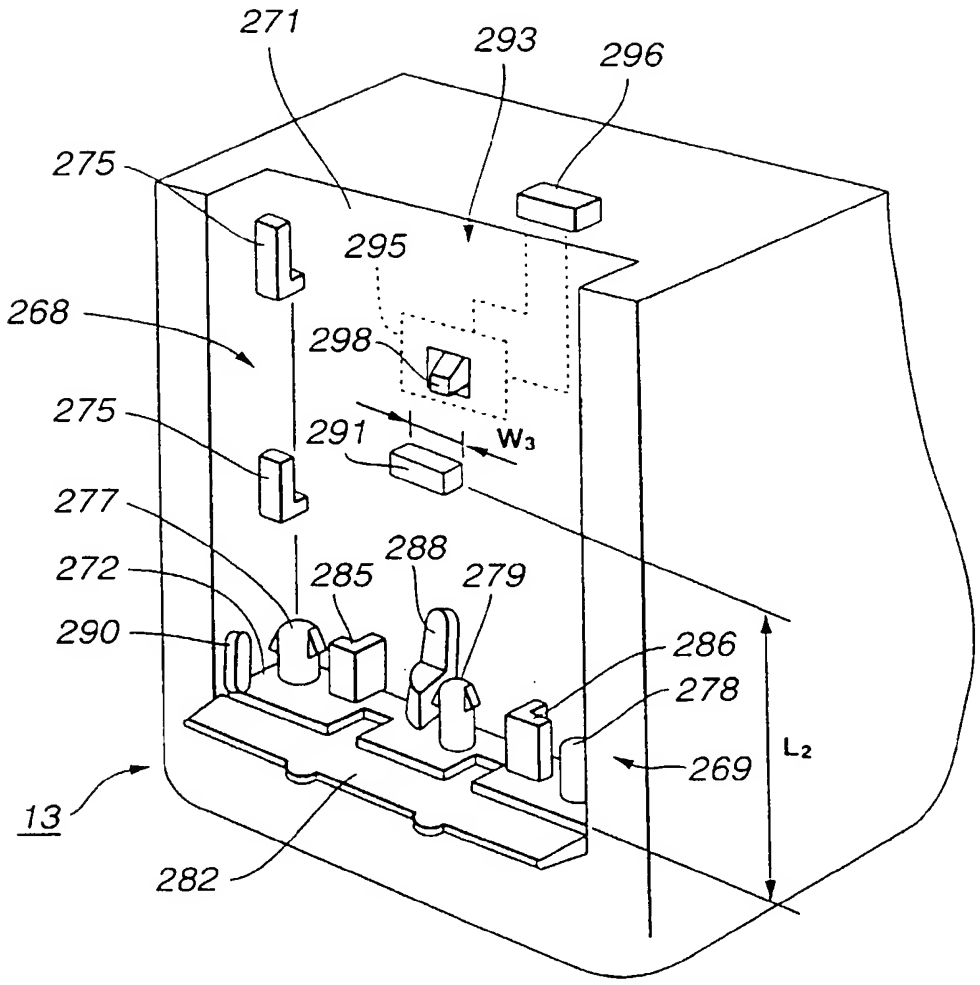


FIG.24

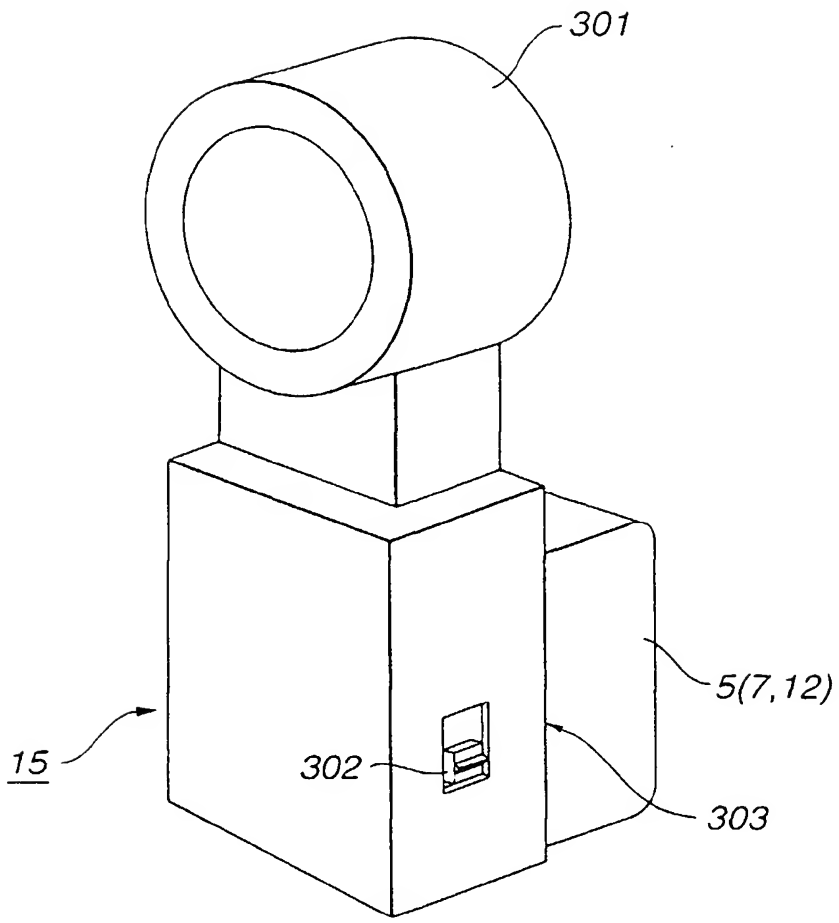


FIG.25

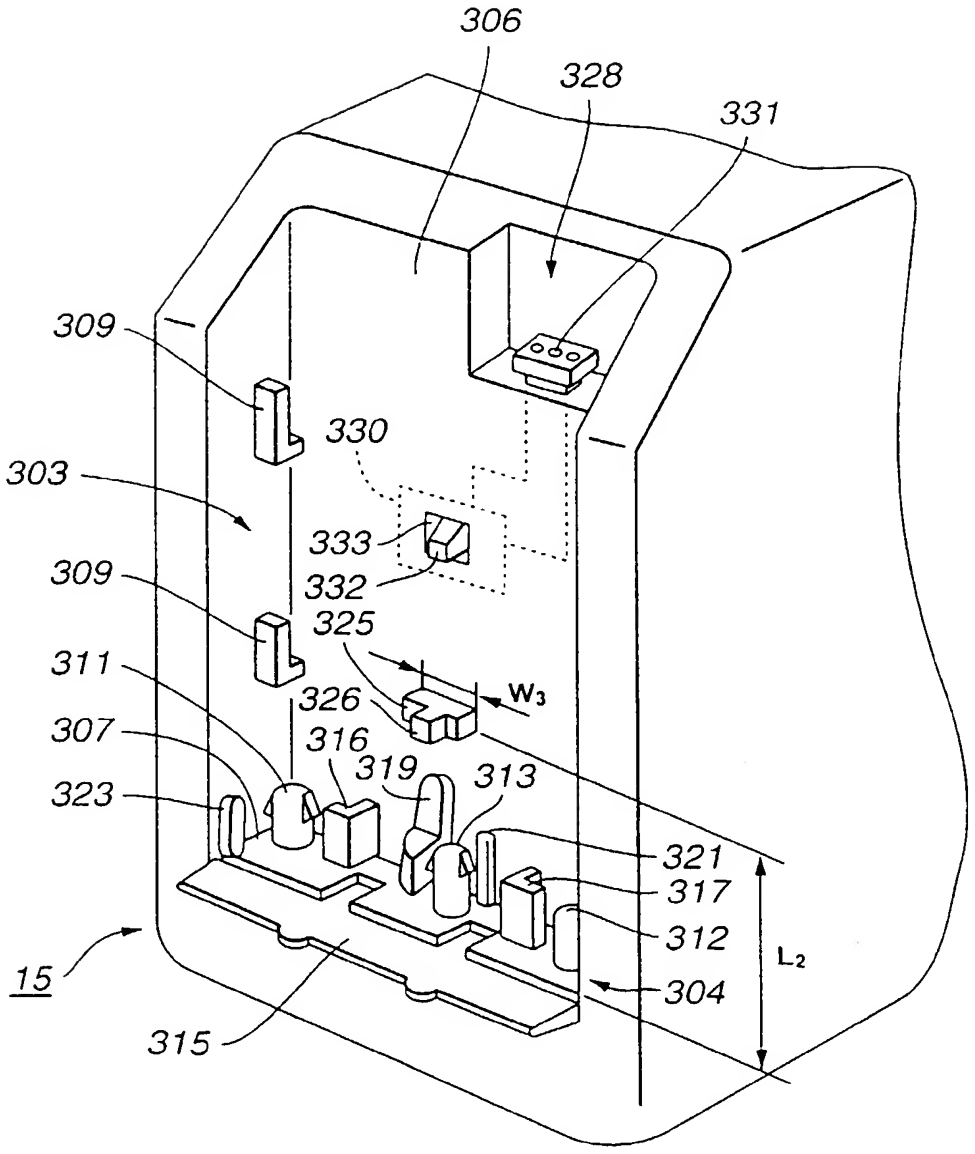


FIG.26

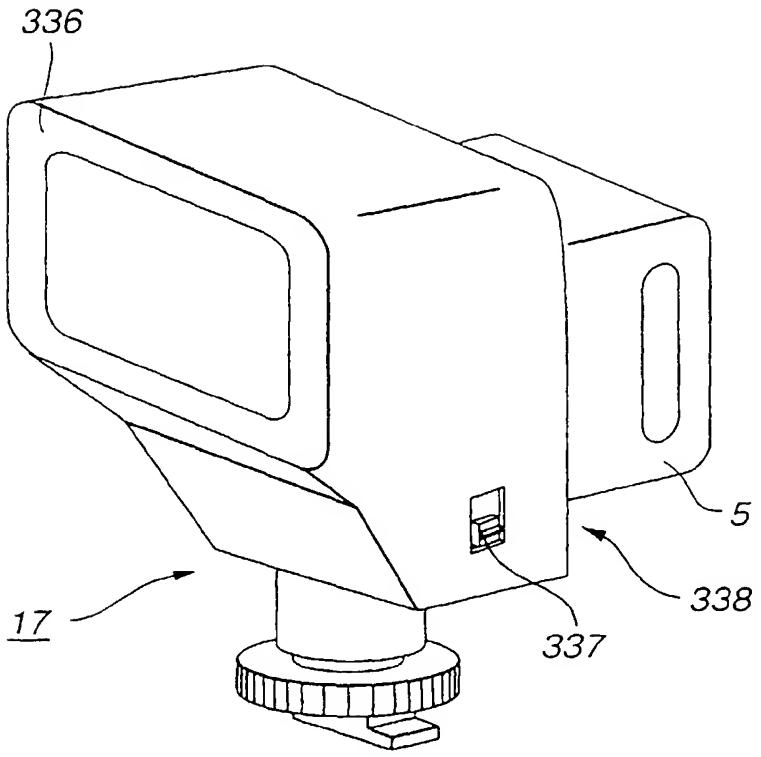


FIG.27

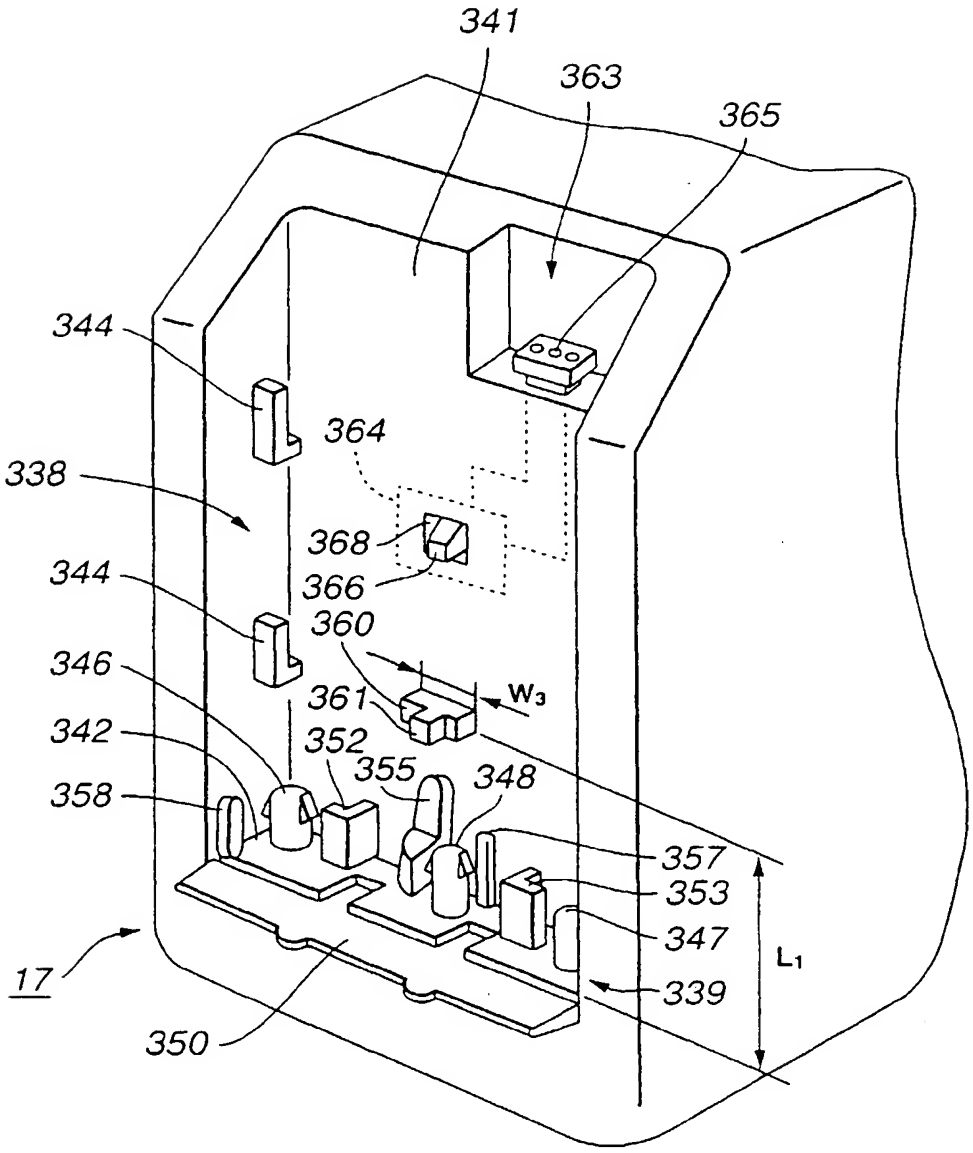


FIG.28

European Patent Office

EUROPEAN SEARCH REPORT

Application Number EP 00301226.7

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl. 7)
A	EP 0572327 A (SONY CORPORATION) 01 December 1993, the whole document. --	1-17	H01M2/06 H01M2/10
A	US 4515872 A (OKANO) 07 May 1985, the whole document. ----	1-17	

TECHNICAL FIELDS SEARCHED (Int. Cl. 7)

H01M

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
VIENNA	17-04-2000	STEPANOVSKY

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
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T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
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L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 00301226.7

This annex lists the patent family members relating to the patent documents cited in the above-mentioned search report. The members are as contained in the EPIDOS INPADOC file on 02.05.2000. The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

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